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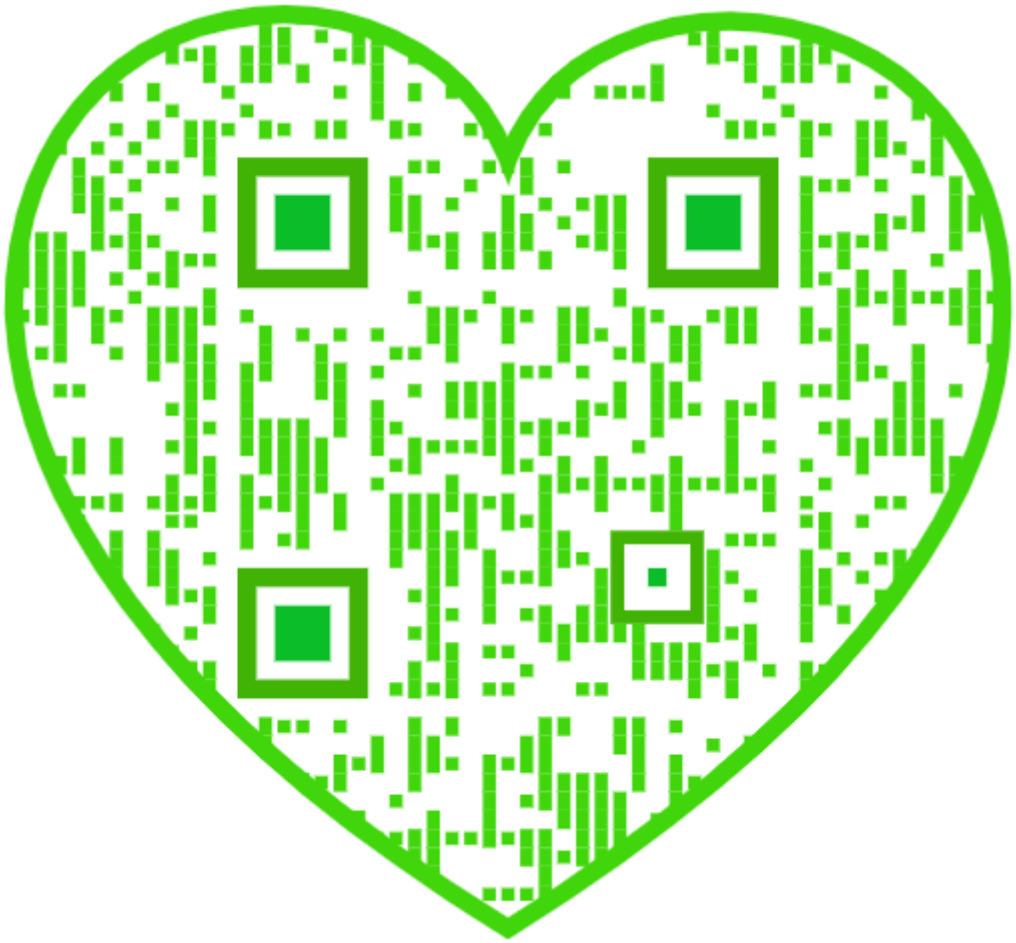

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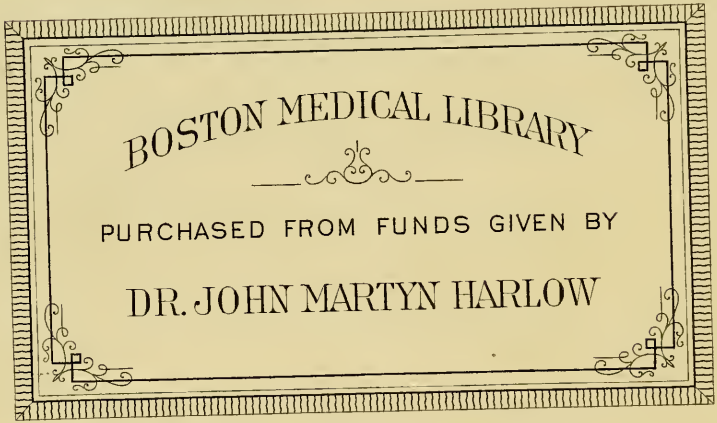

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MANUAL OF
SPLINTS AND APPLIANCES
FOR THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY

Report of a Board convened for the purpose of standardizing certain Medical Department supplies

Lieut.-Col. William L. Keller, M.C.
Major Robert B. Osgood, M.R.C.
Major Alexander Lambert, M.R.C.
Major Joseph A. Blake, M.R.C.
Captain W. S. Baer, M.R.C., and
Captain Nathaniel Allison, M.R.C.

NEW YORK

OXFORD UNIVERSITY PRESS

AMERICAN BRANCH: 35 WEST 32ND STREET

LONDON, TORONTO, MELBOURNE, AND BOMBAY

1917

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HEADQUARTERS
AMERICAN EXPEDITIONARY FORCES
OFFICE OF THE CHIEF SURGEON

September 9, 1917.

From: Chief Surgeon

To: Commander-in-Chief, A.E.F

Subject: Report of a Board convened for the purpose of standardizing certain Medical Department supplies.

1. Inclosed herewith is the report of the Board convened by Paragraph 17, Special Orders, No.73, Headquarters, A.E.F., France, August 20, 1917.

1 Incl.

A. E. Gorgas

Approved.

John J. Pershing
Major
General

HEADQUARTERS
AMERICAN EXPEDITIONARY FORCES

Special Orders, No. 73 France, August 20, 1917.
Extract

* * * * *

17

A board of medical officers is hereby appointed to meet at these headquarters, at the call of the President thereof, for the purpose of investigating and reporting upon the advisability of standardizing certain appliances to be used by the Medical Department, and upon completion of this duty will return to their proper stations. Detail for the board.

Lieut. Colonel William L. Keller, M.C.,
Major Robert B. Osgood, M.R.C.,
Major Alexander Lambert, M.R.C.,
Major Joseph A. Blake, M.R.C.,
Captain W. S. Baer, M.R.C., and
Captain Nathaniel Allison, M.R.C.

The board will be guided by instructions from the Chief Surgeon.

The travel directed is necessary in the military service.

* * * * * *

By command of Major General Pershing.

Official.
Benj. Alvord,
Adjutant General.

JAMES G. HARBOARD,
Lt Col. General Staff,
Chief of Staff.

FOREWORD

In accordance with Special Order No. 73, A.E.F., August 20th, 1917, the Board of Medical Officers directed to investigate and report upon the advisability of standardising certain appliances to be employed and issued by the Medical Department of the United States Army makes the following report:—

This Board met as directed, and in its report recommends that in addition to standardising the manufacture of splints and appliances a manual describing their proper use be published and distributed to all United States Army medical officers at home and abroad.

The Board was unanimous in its opinion that the splints and appliances officially adopted by the American Army should possess the following qualifications:—

1. *Efficiency* and *correct mechanical principles.*

2. *Simplicity of design and low cost of construction* so that sufficient quantities may be always available.

3. *Transportability,* in order that an efficient splint may be applied at the Front and remain *in situ* until the patient reaches the more or less permanent Base Hospital, and, if occasion demands or the surgeon elects, may

even be expected to make possible an entirely satisfactory end result, without change of the type of splint.

The Medical Department has no desire to dictate the exact line of treatment which shall be employed in the Base Hospitals. It is the desire, on the contrary, to encourage ingenuity in devising better methods for the treatment of these bone and joint injuries, which comprise so large a proportion of the battle casualties. The Board is convinced, however, after a careful review of existing methods in the armies of the Allies and enemies, and a personal experience in the active treatment of these lesions in the present war, that the simple apparatus recommended may be employed with entire satisfaction as to the end results, and without any great degree of previous training.

The Board believes that with the three types of wire-ring traction and counter-pressure fixation splints embodying the Thomas principle, the Jones "Cock-up" "Crab" wrist splint, the long interrupted Liston splint with adjustable foot piece, an anterior thigh and leg splint, Hodgen type, the Cabot posterior wire splint, the wire-ladder splint material, light splint wood, and plaster of Paris bandages and Bradford frames, treatment of all bone and joint battle casualties may be efficiently carried out at the Front, and if necessary in base hospitals.

Holding this belief they have been influenced in thus restricting their recommendations to the above types of splints and splint material, by a consideration of the following advantages which their universal use would secure:—

1. Possibility of quick manufacture and ease of distribution, thereby making available large numbers of splints of unit construction.

2. The combination of traction and fixation in the same apparatus, thereby favouring the comfort of the patient and avoiding the necessity of accessory adjustment.

3. Universality of type and simplicity of mechanical principle, thereby insuring quick familiarity with their uses and efficient application by the surgeon.

The Board believes that it is the first duty of all surgeons to become familiar by actual practice in applying the splints to living models, with the methods herein recommended, the mechanical principles underlying these methods—namely, fixation and traction—and the details of the apparatus advised.

Since the successful treatment of these injuries depends so much upon the absence or limitation of infection in these compound fractures, they have seen fit to discuss the primary dressings and the line of mechanical after-

treatment found most constantly to favour the healing of wounds, the union of bones, and the restoration of function.

It will at once be obvious that this manual does not aim to be a complete treatise on the treatment of this class of lesions. Its purpose is to put into the hands of the military surgeon a practical, time-saving guide, in which the text has been made completely subservient to graphic illustration.

The Board considers that the simplification of methods and apparatus is of supreme importance, not only in the immediate care of the wounded, but in diminishing the national burden of the cripple.

The Board wishes to express its gratitude to Mrs. Cyrus W. Thomas for her voluntary and patriotic service in making the drawings for this manual, and to Mrs. Gertrude Austin for her most valuable co-operation in connection with the dressings and surgical supplies.

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PART I

GENERAL CONSIDERATIONS AND DETAILED DESCRIPTIONS OF SPLINTS AND APPLIANCES RECOMMENDED FOR USE AT FIELD AND EVACUATION HOSPITALS.

CHAPTER I

General Considerations.

The chief objects in the application of splints and in the after-treatment of bone and joint injuries by means of splints and other apparatus are

1. The comfort of the patient.
2. Assistance towards the healing of his lesion.

The ends sought are gained by splints or apparatus which

1. Cause the least possible disturbance of the patient in application.
2. Do not produce pressure upon sensitive parts.
3. Allow freedom of movements of other segments of the body while the injured part remains immobile.

These ends are gained by the fulfilment of two mechanical principles:—

1. Fixation.
2. Traction.

1. Fixation.

(*a*) To obtain rest for the injured structures.
(*b*) To retain proper alignment after this alignment has been secured.
(*c*) To favour union in fractured bones.

2. Traction.

(*a*) To obtain muscular relaxation with the object of diminishing pain and inhibiting the muscular contraction which results in malposition.

(*b*) To secure proper alignment by a pull in the direction of normal anatomical lines.

(*c*) To prevent the displacement of bony fragments and consequent laceration of nerve, muscle, and vascular tissue.

(*d*) To facilitate the dressing of wounds.

Fixation.—No satisfactory fixation can be obtained unless the splinting material used extends well above and well below the lesion. If possible the joint above and the joint below should be included in the fixation. In the case of a joint, both the entire shaft above and the entire shaft below should be included in the fixation.

Fixation Material.—The fixation material recommended in the special splints, to be described, consists with one exception of rust-proof iron wire. In the wire splints advised for the long bones and the main joints this wire is from ¼ to ⅜ inch in diameter. The splints consist of two lateral rods 6 to 8 inches longer and 1 to 2 inches wider than the limb. At the distal extremity these rods are continuous, forming an indentation or notch, beyond the extremity. At the top they are united to a complete or half-ring of padded wire. (See pages 97, 107 and 111, Figs. 5, 10 and 12.)

Traction.—The purpose of the ring is to allow the upper end of the splint to be pressed hard against a fixed bony part. The purpose of the

indentation or notch is to furnish a fixed point about which traction may be applied through the agency of bands fastened to the limb. The pull is transmitted from the fixed point by means of the metal rods to the counter bony part against which the padded ring is impinging.

Great care of the skin must be exercised at the point of impingement. The ring leather should be soaped before application, and the skin frequently bathed with alcohol and dusted with Talcum powder. Frequent slight changes in position of the splinted limb change slightly the points of pressure, and diminish the danger of pressure sores.

Traction Material.—The traction is obtained by means of an adhesive material fastened to the skin. Zinc oxide adhesive plaster (rubber base), while fairly non-irritating, furnishes a less stable extension than Diachylon plaster. The latter must be warmed over a flame before being used. Strips at least two inches in width should be applied to the sound skin for the length of a foot, or as great a length as the wounds will allow. They should be reinforced by diagonally crossing (Page 89, Fig. 1 (2 and 3)) strips and a snug bandage applied. The lower end of the strip should extend at least 8 inches below the sole of the foot or 4 inches beyond the tips of the fingers, and the sticky surfaces covered with a piece of bandage so that they will not adhere. These ends are now passed through the buckles of webbing straps or tied to pieces of stout bandage, which in turn are passed the one over the other under the wire rods of the splint and returning to the centre of the splint wound in opposite direction once around the indentation or notch at the lower end

of the splint and tied. A wire nail or a small piece of wood, in length about the width of the lower end of the splint, is now inserted an inch or two between the extension bands about 2 inches from the end of the splint, and the amount of traction increased to any extent by twisting after the manner of a Spanish windlass or the old-fashioned buck-saw rope. This is retained by catching the end of the nail or piece of wood under or over one of the rods of the splint as the twist requires (Page 91, Fig. 2). In this manner a constant traction may be maintained, and tightened or loosened without untying the original knot.

Many surgeons prefer to use a glue painted on the leg with a brush, the last stroke of the brush being upwards in the direction opposite to the growth of the hair. The extension strips of stout unbleached muslin bandage or several folds of gauze covering as much of the available skin surface as possible and reaching at least six inches below the end of the splints are then applied and bandaged on. Traction is obtained by the same method as with the adhesive plaster and twister. Two forms of glue are in general use.

1. Sinclair's Glue:—

Ordinary glue	50	parts
Water	50	"
Glycerine	2	"
Calcium Chloride	2	"
Thymol	1	"

This glue should be heated in a water bath over 100° F. before using.

2. Resin and Turpentine Glue:—

Resin	50 parts
Alcohol	50 "
Benzine (pure)	25 "
Venice Turpentine	5 "

Powder the resin, then add half the alcohol, then the Venice turpentine and benzine, washing the measure into the bottle with the remaining alcohol. This glue may be removed with alcohol or ether. The bottle containing the glue should be kept tightly stoppered else the proportions of the constituents may change, and the glue become irritating to the skin. This glue does not require heating before use, and should not be applied too thickly.

Moderate traction may be safely instituted with both these forms of glue in from 5 to 10 minutes after application, and as much traction as is required in 20 minutes.

An excellent traction may be obtained by a light-weight army sock. The lower leg, ankle, and foot, with the exception of the toes and the plantar surface, are painted with glue and the sock slipped on. The toe of the sock is cut off, and a piece of light splint wood or the ladder splint material, to be described, cut the length of the foot, is inserted between the sole and the sock. Traction may then be made on this by means of pieces of bandage or cord passed through the sock and around the wood or the rods of the ladder splinting (Page 93, Fig. 3).

In the field a canvas anklet (Page 95, Fig. 4) will be found useful. It may be quickly applied around a well-padded foot or even over an army shoe, and in numerous cases will be found to offer the most practical appliance by which leg traction may be obtained. If the shoe is removed the foot should be generously padded with cotton or felt which should be snugly and evenly bandaged on before the anklet is applied.

A long wire nail or steel pin may be forced through the sole of the boot just anterior to the heel, and traction bands fastened to its ends.

These wire-ring and counter-pressure splints are generally known as the Thomas leg and arm traction splints, devised by Hugh Owen Thomas of Liverpool. They have been modified and adapted to compound fractures and joint injuries as will later appear, but the underlying principles are identical with those advocated by Thomas fifty years ago. In the opinion of the Board, and in the experience of the British and American Medical Departments they lend themselves in a peculiarly fortunate manner to the conditions of military surgery.

CHAPTER II

Detailed Descriptions of Splints and Appliances for the Upper Extremity.

Thomas Traction Arm Splint.

Patient recumbent.

(See illustration of splint and application, pages 97 and 99, Fig. 5 (1) and Fig. 6.)

Identical splints for both right and left sides of the body.

Uses: (*a*) Injuries to the shoulder joint,
(*b*) Injuries to the shaft of the humerus,
(*c*) Injuries to the elbow joint,
(*d*) Injuries to the forearm.

DESCRIPTION OF SPLINT.

The splint consists of a padded circular ring 7½ inches in diameter and two rods 34 inches in length. At the ring these rods are 7½ inches apart and at the bottom they are continuous in an indented or notched end, 2½ inches in width, about which the traction bands are wound and knotted. The space between the rods may be widened or narrowed by bending them outward or inward.

Murray's Modification of the Thomas Arm Splint.

Patient recumbent or to a limited degree ambulatory.
(See illustration of splint and application, pages 97 and 101, Fig. 5 (2 and 3) and Fig. 7.)
Identical splints for both right and left sides of the body.

Uses: (*a*) Injuries to the shaft of the humerus,
(*b*) Injuries to the elbow joint,
(*c*) Injuries to the forearm.

DESCRIPTION OF SPLINT.

The splint consists of a padded ring of the same shape and size as in the Thomas arm splint. The rods are made of the same wire and are of the same length and the same distance apart as the Thomas arm splint. The modification consists of a joint between the rods and the ring, either by means of a hinge 1½ inches below the ring or by making loops of the rod wires close to the ring, which loops receive similar loops at the upper ends of the rods.

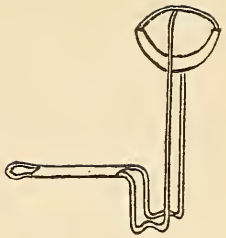
The purpose of the splint is to provide close apposition of the ring to the shoulder and thorax and still allow the injured limb to be brought to the side of the body—an important factor in recumbent transportation.

Jones Humerus Traction Splint.

Patient may be ambulatory.

(See illustration of splint and application, page 103, Fig. 8.)

Different splints for right and left sides of the body.



Uses: (*a*) Injuries to the shaft of the humerus in which traction on the humerus and flexion on the elbow joints are desired.

(*b*) Elbow joint injuries in which flexion is desired.

(*c*) Injuries to the forearm.

DESCRIPTION OF SPLINT.

A padded half ring to fit in the axilla like a crutch, 7½ inches in diameter. The wire of the half ring is continued to form a complete circle, which is bent on itself at right angles to outline a quarter sector of a sphere. The right angle wire half circle extends out over the shoulder and upper arm and is not padded. The wire rods, ¼ inch in diameter, descend from the centre of the padded axillary crutch and from the centre of the right angle unpadded shoulder portion of the ring. The inside rod next to body is 14 inches long and the outside rod is 18 inches long, curved outward slightly over the convexity of the deltoid. The rods terminate in indentations or notches about which the humeral traction bands are wound and tied. The rods then ascend for 4 inches and at this point are bent at a right angle in the same

plane as the humeral rods; they then extend forward for 12 inches, 4½ inches apart, to form a continuous splint for forearm, wrist and metacarpal fixation.

The Jones "Cock-Up" or "Crab" Wrist and Forearm Splint.

(See illustration of splint and application, page 105, Fig. 9.)

Identical splints for right and left sides of the body.

Uses: To retain the position of dorsal flexion of the hand in cases of injury to the wrist and in nerve and muscle lesions which produce "wrist drop."

DESCRIPTION OF SPLINT.

To a piece of thin sheet iron, about 8 by 4 inches, shaped like a hollow trough, a flat soft-iron rod, ¾ of an inch in width and ⅛ of an inch in thickness, is riveted. This flat iron rod extends distally from the sheet iron trough about 10 inches, bending upward at about 6 inches distally from the edge of the trough. At the distal end of the rod is riveted by a single rivet a very light flat iron cross-bar, 5 inches in length and turned up at either end. At 4 inches distally from the trough is riveted a very light flat iron cross-bar, 3 inches in length.

Any degree of dorsal flexion of the hand may be obtained by varying the bend of the central iron rod.

The splint is applied to the forearm and metacarpo-phalangeal junction of the hand and retained by bandages or adhesive plaster. It should be used in cases of partial or total "wrist drop." If it is desirable to retain a fully extended position of the fingers, a piece of ladder splint material, to be described, see page 125, Fig. 19, may be used as a "Cock-up" splint.

SELECTION OF TYPE OF UPPER EXTREMITY TRACTION SPLINT FOR DIFFERENT LESIONS.

1. Thomas Traction Arm Splint, page 97, Fig. 5 (1).
2. Hinged Modification of Thomas Arm Splint, page 97, Fig. 5 (2 and 3).
3. Jones Humerus Traction Splint, page 103, Fig. 8.

1. Thomas Traction Arm Splint.

Patient recumbent, except in rare cases where special transportation can be provided.

The classical Thomas arm splint is not applicable at the Front or at an evacuating station to cases of injury of the shoulder girdle or upper extremity, since the position of abduction and distal support which it requires make ambulance or stretcher transport difficult.

2. Hinged Modification of Thomas Arm Splint. (See page 97, Fig. 5 (2 and 3.)

Patient recumbent, or, to a limited extent, ambulatory.

Useful for all injuries of the upper arm, elbow, and forearm where fixation and traction are desirable and where ideal position may be temporarily sacrificed to ease of transportation.

3. Jones Humerus Traction Splint.

Patient recumbent or ambulatory. (See page 103, Fig. 8.)
Right and left splint.

Useful for injury to the upper arm and elbow where flexion of the elbow with fixation of the humerus and elbow, and traction on the humerus with moderate traction on the elbow joint, are desirable. A slight amount of traction on the forearm may be obtained.

CHAPTER III

Detailed Descriptions of Splints and Appliances for the Lower Extremity.

Thomas Traction Leg Splint.

Patient always recumbent.

(See illustration of splint and application, pages 107 and 109, Figs. 10 and 11.)

Identical splints for right and left sides of the body.

Uses: (*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

DESCRIPTION OF SPLINT.

The splint consists of a padded ring, slightly ovoid in shape, set upon two iron wire rods at an angle of 55 degrees with the outer rod. The rods are 3/8 of an inch in diameter. At the inner and shorter of these two rods the ring is twice as heavily padded as at the outer, and the ring is symmetrically depressed at either side of the inner rod to form a concavity which hugs the ischial ramus and fits snugly around the ischial tuberosity. The long and short diameters of this ring vary

since the splint as used by the British army comes in several sizes, but a ring of average size measures across the long diameter 9½ inches and across the short diameter 9 inches. The outer rod descends from the ring vertically for 2½ inches and then inclines towards the inner rod. At the starting point of the inner rod the two wires are 8½ inches apart and at the bottom they are continuous in an indented or notched end, 3½ inches in width, about which the traction bands are wound and knotted. (Nail or wood twister is inserted as in the Thomas arm splint.) The outside rod is 47 inches in length and the inside rod 42 inches in length. The space between the rods may be varied by bending them outward or inward. If desired the splint may be bent at the knee.

The Hinged Half-Ring Modification of the Thomas Traction Leg Splint.

Patient always recumbent.

(See illustration of splint and applications, pages 111 and 113, Figs. 12 and 13.)

Identical splints for both right and left sides of the body.

Uses: (*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

The splint consists of a padded half ring set upon two iron rods 3/8 of an inch in diameter. (The indentation at the inner rod has been omitted, having in practice been found unnecessary.) The half ring forms an angle of 55 degrees with the outer and longer rod, and the ring is fastened to both rods by a stout joint which allows it to be moved through an arc of 180 degrees. At the junction of the inner rod and half ring is fastened a strap of webbing or leather and at the junction of the outer rod and half ring is fastened a buckle. The posterior half ring is thereby kept in close apposition to the limb. The rods are the same distance apart and the same shape and size as in the Thomas leg splint. The space between the rods may be varied by bending them outward or inward. If desired the splint may be bent at the knee.

The Advantages of the Hinged Half-Ring Modification of the Thomas Splint are:

1. Ease of application without passing a complete ring, as in the Thomas splint, over the injured limb.
2. Ease of access to wounds of the groin because of the absence of the rigid anterior portion of the Thomas complete ring.
3. Possibility of use as an anterior leg splint for fixation and suspension, after the manner of the Hodgen splint.
4. Ease of packing for transport.

The Long Liston Splint.

Patient always recumbent.

(See illustration and application, pages 115 and 117, Figs. 14 and 15.)

Identical splints for right and left sides of body.

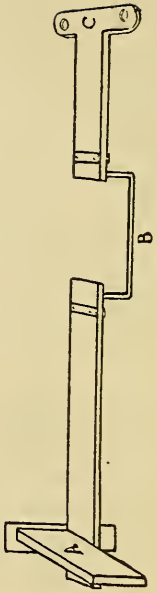
Uses: (*a*) Multiple injuries to the body and limb requiring fixation for comfortable transport.

(*b*) Injuries to the pelvis requiring fixation in transport.

(*c*) Injuries to the hip joint requiring fixation and abducted position in transport.

The Board recommends, for transportation only, the use of the long Liston hip and thigh splint, which is the one exception to the open rust-proof iron-wire type of splints.

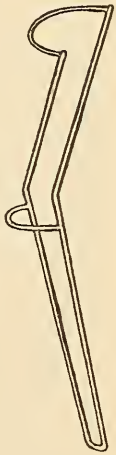
As usually applied the splint offers no support posteriorly, which is a serious disadvantage in hip joint and upper thigh injuries. It should rarely be used for these conditions.



DESCRIPTION OF SPLINT.

The splint consists of two pieces of flat wood of unequal lengths. The wood is ½ inch thick and 3 inches wide. The shorter of these two pieces is 14 inches long and to its upper end is fastened a wooden cross-bar, 9 inches long and 2 inches wide, penetrated at either end by an inch hole through which

bandage material may be run for fastening the splint to the thorax. The longer of these two pieces of wood is 32 inches in length and is perforated at the centre through its lower 15 inches by small holes 2 inches apart; these holes receive the thumb screw set-nut of the foot piece. These two pieces of wood are joined together by a bridge of iron wire, 3/8 inch in diameter; the span of this bridge is 9 inches and its elevation is 2 inches. The wooden foot piece is 12 inches in length, 4 inches in width, and 3/4 inch in thickness, set at right angles to the lower leg splint and adjustable to different lengths of limbs, by means of the thumb screw set-nut and holes. If an abducted position of the limb is desired, the iron wire bridge may be bent to accomplish this purpose.



Anterior Thigh and Leg Splint, Hodgen Type.

Patient recumbent.

(See illustration and applications, pages 119, 171 and 173, Figs. 16, 42 and 43.)

Different splints for right and left sides of body.

The Board recommends the use of a wire anterior thigh and leg splint of the Hodgen type, chiefly for use in base hospitals.

Uses: For suspension of the limb from overhead support in injuries to the thigh and leg.

The splint consists of a quadrilateral frame of ⅜-inch wire, the inner rod is 35 inches long, the outer rod is 39 inches long, the distal ends of the rods are continuous and form an end 5 inches in width. At 11½ inches from the proximal end of the inner rod and 15½ inches from the proximal end of the outer rod both rods are bent to allow flexion of the knee to approximately 30 degrees. Two 3/16-inch wire half circles unite the two rods. One half-circle spans the rods, being attached to the upper ends of the rods, the other half circle spans the rods immediately distal to the knee bend. The splint affords no opportunity for traction and counter pressure. It is a rigid lateral and anterior support from which the limb is suspended by means of slings, snapped, or pinned, to the lateral rods. It is useful chiefly in base hospitals where overhead frames are available and suspension may be obtained by weights and pulleys.

Cabot Posterior Wire Leg Splint.

Patient always recumbent.

(See illustration of splint and application, pages 121 and 123, Figs. 17 and 18.)

Identical splints for the right and left sides of body.

Uses: (*a*) Injuries to the soft parts of the lower limb requiring fixation in transport.

(*b*) Slight injuries to the knee or ankle requiring fixation in transport.

(*c*) Fractures of the fibula or tarsus.

The Board recommends the use of a wire retentive foot and leg splint devised by the late Arthur T. Cabot of Boston.

DESCRIPTION OF SPLINT.

The splint consists of a quadrilateral form of ¼ inch wire 7 inches in width at the upper portion, which is bent at right angles and concave to conform to the convex surface of the upper thigh. It narrows at the heel and at this point is bent upward to form a right angle foot piece 12 inches in height and 4 inches wide. For use, this frame of wire is bandaged and padded and usually bent slightly at the knee. It is retained in position on the limb by adhesive plaster straps applied:—

1. As near the upper limit of the splint as possible,
2. Above the ankle joint proximal to the malleoli,
3. About the foot just proximal to the great toe joint.

Splints made of light splint wood or the wire ladder splint material (to be described) are applied posteriorly and on either side of the limb, and are fastened and retained by webbing straps and buckles. The ease of application and adaptability of this splint present the danger of its too general employment.

The Board recognises the frequent maltreatment encountered by the customary use of the ordinary ham splint and the straight posterior wood splint with a right-angle foot piece. The application of the posterior wire splint should be scrupulously restricted to wounds of muscular tissue, slight injuries to the knee joint, fractures of the fibula, injuries to the ankle joint and tarsus not requiring traction in addition to fixation.

The traction and counter-traction principle of the Thomas splint and its modifications should be maintained in all cases where there is solution of continuity of the bone with the possibility of displacement of fragments, or where the traumatic lesion of the joint is likely to result in serious infection and muscular contracture.

SELECTION OF TYPE OF LOWER EXTREMITY SPLINT FOR DIFFERENT LESIONS.

1. Thomas traction leg splint or hinged half-ring modification of Thomas traction leg splint, pages 107, 109, 111 and 113, Figs. 10, 11, 12 and 13.

2. Long Liston splint with bridge interruption, pages 115 and 117, Figs. 14 and 15.

3. Cabot posterior wire splint side and posterior splint, pages 121 and 123, Figs. 17 and 18.

4. Plaster of Paris bandages, jackets and spicas. (See page 153, Fig. 33.)

1. Thomas Traction Leg Splint or Hinged Half-Ring Modification.

Applicable near the Front and at evacuation hospitals to nearly all of the injuries to the lower extremity below the hip joint. For transportation the

stretcher should be supplied with a cradle bar from which the splint and leg may be suspended. (See page 113, Fig. 13.)

2. Long Liston Splint with Bridge Interruption.

Applicable near the Front and at evacuation hospitals for transportation in injuries of the pelvis or hip joint.

3. Cabot Posterior Wire Splint, Side Splints and Posterior Splint.

Applicable to wounds of the soft parts and slight injuries of the knee joint without marked effusion. Also to fracture of the fibula and injuries to the ankle and tarsus. This splint provides only immobilisation and should be used with great caution. Side splints and the posterior splint of wire ladder splint material, see pages 123 and 125, Figs. 18 and 19, or light splint wood should always be applied for transportation. If these are omitted the limb is likely to rotate and additional strain be brought on the knee or ankle joint.

4. Plaster of Paris Bandages, Jackets and Spicas.

See description, page 23. Lesions of the spine, pelvis, and hip joints, plaster of Paris fixation provides great safety and comfort in transport. Their application entails considerable labour, but they have a distinct place even at the Front and evacuation hospitals.

CHAPTER IV

Additional Splinting Material and Appliances.

1. A Material known as the "Ladder Splint."

This ladder splint material is made of galvanised iron wire ⅛ of an inch in diameter, two pieces running parallel to each other about 3½ inches apart. At one end the wire is continuous and forms a terminal 3½ inches in width. The lateral wires are joined by smaller 1/16-inch wires slightly arched at a distance of ¾ of an inch from each other. This material is furnished in 30-inch lengths and may be cut by a file or heavy wire cutters into lengths desirable for coaptation splints, or for the fixation of the hand, foot, forearm, elbow, or knee.

2. Light Splint Wood.

Three-sixteenth inch in thickness, in pieces 30 inches long and 3 inches wide. Used for small splints, side splints, etc.

3. Plaster of Paris Bandages.

In moisture-proof containers, made from fine ground dry plaster and loosely rolled starch-sized crinoline bandages 30 to 50 threads to the inch, 5 yards long, and 5 inches wide.

Uses: The immobilisation of serious lesions of the spine, pelvis and hip joint. Plaster jacket, plaster spica.

The plaster bandages should be soaked on their side in luke-warm water until thoroughly saturated. They should then be partially wrung out by grasping the two ends with the two hands and gently twisting. They should be applied over a light smooth sheet wadding bandage or over stockinette. All bony prominences should be padded with several extra layers of sheet wadding or saddler's felt.

(*a*) *The plaster jacket.*—For serious lesions of the spine the jacket should be applied with the patient resting on a hammock or on a sufficient number of webbing straps stretched across a Bradford iron pipe frame. The jacket should include the pelvis and be well moulded over the crests of the ilia and be padded over the anterior superior spines. It should extend as high as possible in front and back. It should be trimmed out in the axillæ to allow free motion of the arms without pressure.

(*b*) *Plaster spica.*—For fracture of the pelvis. The spica should be applied with the patient resting in the same way as for the plaster jacket or with the buttocks resting on a special pelvic rest or the up-turned bottom of a dressing basin with the shoulders supported by a box, or pillows. The spica should include the lower thorax and be well moulded over the crests of the ilia and padded over the anterior superior spines. It should extend on the thigh to include the flare of the femoral condyles. Great care should be exerted in including as much as possible of the buttock in the bandage. Over the region

of the groin the bandage should be reinforced by extra folds of plaster bandage—it is here that it usually breaks.

4. The Gas Pipe Frame known as the Bradford Frame.

Used for transport of patients with serious lesions of the spine or fracture of the pelvis.

DESCRIPTION OF FRAME.

(See illustration, page 127, Fig. 20.)

The apparatus consists of a quadrilateral frame, 6 feet long by 2 feet wide made of 1-inch rust-proof iron pipe. (See illustration of Maddox Unit Clamps, pages 135, 137 and 139, Figs. 24 (1), 25 and 26.) Across this frame are laced swathes 12 inches wide, so arranged as to provide proper support and avoid wounds. The frame may be used as a stretcher or be superimposed upon a stretcher. The patient should be allowed to remain on the frame in the bed of the hospital to which he is transported until other apparatus has been arranged.

PART II

GENERAL CONSIDERATIONS AND DETAILED DESCRIPTIONS OF SPLINTS AND APPLIANCES RECOMMENDED FOR USE AT BASE HOSPITALS.

CHAPTER I

General Considerations.

As was stated in the introduction to the Manual, the Board believes that in Field and Evacuation hospitals the splints and appliances should be as compact and simple in design and as few in number as is consistent with the comfort of the patient and the efficient treatment of his lesions. The restriction of the armamentarium to these splints and appliances entails no sacrifice of the mechanical principles of fixation and traction so important to maintain in the great majority of war injuries of the bones and joints. On the contrary the Board is convinced that this restriction will result in far better treatment at the front than a greater possibility of choice in the hands of the average surgeon, who must for a time at least approach the problems of military surgery without a large previous experience.

At the Base hospital where the patient is expected to remain until he becomes convalescent the conditions change, and, while methods of treatment are of even greater importance, these conditions are less exacting since the comfortable and safe transport of the patient is not an immediate problem.

With certain exceptions it is quite possible to continue the successful treatment of the lesions by means of the original apparatus applied near the Front, but frequently the comfort of the patient may be increased and the healing of his wounds may be favoured by more specialised appliances.

In this section, therefore, the original splints are mentioned with reference to the illustration and to the more detailed description given in the first section. There then follow descriptions of the appliances which the Board believes will be found most useful in a base hospital, but which they believe in most instances are impracticable for any general use at the Front.

Certain apparatus for overhead suspension by means of pulleys and counterweights will be found advantageous in many instances for the treatment of bone and joint injuries of both the upper and lower extremities.

If a fractured limb can be held in such a position that the muscles whose contraction would tend to produce deformity are no longer stimulated to function—*i.e.,* in a position of "physiological rest"—it requires little force to keep the fragments in place. This is often most perfectly accomplished by traction weights and overhead pulley and weight suspension.

Overhead suspension may be obtained in two ways:

1. By constructing a complete quadrilateral frame of wood or metal. This has been called the Balkan Frame. The original Balkan frame, however, consisted of one bar over the bed.
2. By erecting one or more special overhead props to which one or more pulleys may be fastened.

Pulleys with Swivel Hook. (See page 129, Fig. 21.)

Strap Iron Hooks for Attaching Pulleys to Frame (see page 129, Fig. 21).

Traction Weights and Counterbalances, Open Canvas Bags and Weight Bags (see page 131, Fig. 22).

Overhead Frames.

(A) After considerable investigation the Board has been convinced that the Blake pattern, see page 133, Fig. 23, of quadrilateral frame erected over the bed has all the merits of the more cumbersome frames and the following advantages:

1. Lightness of construction,
2. Cheapness of construction,
3. Increased rigidity in proportion to weight,
4. Economy of space,
5. Ease of adjustment for different positions.

Material: Wood 7/8 inch by 2 inches, white pine, or other strong soft wood.

Shape: 1. Inward slant of head and foot pieces like truncated A,

2. Crossbars to head and foot pieces the width of the bed,

(*a*) at top extending beyond uprights on either side,

(*b*) at level of top of mattress,

(*c*) longitudinal bars, 2 resting on upper crossbars and retained in any desired position by reciprocal notches (mortise joint).

1. To allow pulleys for counterweight and traction to be placed in any appropriate position for the different lesions of the upper and lower extremities.

2. To furnish support for hand ropes by which the patient may change his position in bed.

(**B**) The Board has also recommended the Maddox unit clamps and pipes, see page 135, Fig. 24 (1). By means of a special clamp, see page 135, Fig. 24 (2), one or more of the pipes may be fastened to the bed-frame at any point. By the use of the clamp and pipes any form of super-structure may be erected, from a single pulley prop to a complete quadrilateral frame, after the manner of the toy called "Mechano." (See pages 137 and 139, Figs. 25 and 26.)

CHAPTER II

Detailed Description of Splints and Appliances for Upper Extremity.

Thomas Traction Arm Splint.

Patient recumbent. Arm in abduction.

(See illustration of splint and application, pages 97 and 99, Figs. 5 (1) and 6.)

Identical splints for both right and left sides of body.

Uses: (*a*) Injuries to the shoulder girdle.
(*b*) Injuries to the shaft of humerus.
(*c*) Injuries to the elbow joint.
(*d*) Injuries to the forearm.

DESCRIPTION OF SPLINT.

(See Part I., Chapter II., page 7.)

Hinged Modification of Thomas Arm Splint.

Patient recumbent or ambulatory.

(See illustration of splint and application, pages 97 and 101, Figs. 5 (2 and 3) and 7.)

Identical splints for both right and left sides of body.

Uses: (*a*) Injuries to the shaft of humerus.
(*b*) Injuries to the elbow joint.
(*c*) Injuries to the forearm.

(See Part I., Chapter II., page 8.)

Jones Humerus Traction Splint.

Patient recumbent or ambulatory.

(See illustration of splint and application, page 103, Fig. 8.)

Different splints for right and left side of body.

Uses: (*a*) Injuries to shaft of humerus in which traction on the shaft of the humerus and flexion of the elbow joint are desired.

(*b*) Elbow joint injuries in which flexion is desired.

(*c*) Injuries to the forearm.

Thomas Traction Leg Splint.

Patient mostly recumbent.

(See illustration of splint and application, pages 107 & 141, Figs. 10 & 27.)

Identical splint for right and left sides of the body.

Uses: Used in injuries to shoulder girdle and upper one-third of shaft of humerus. Arm held in abduction.

SELECTION OF TYPE OF UPPER EXTREMITY TRACTION SPLINTS FOR DIFFERENT LESIONS.

1. Thomas traction arm splint.
2. Hinged modification of Thomas arm splint.
3. Jones humerus traction splint.
4. Thomas leg splint.
5. Adaptations of Thomas and Jones splints to secure ambulatory abduction of arm and fixation of the shoulder girdle.

1. Lesions of the Shoulder Girdle and Upper Third of the Humerus.

Position of Fixation.—Arm in abduction of 90 degrees, hand half-way between pronation and supination. In fractures of the forearm the hand should be more supinated.

A. Thomas Leg Splint or Hinged Half-Ring Modification.

Patient mostly recumbent.

(See illustration and application, page 141, Fig. 27).

DESCRIPTION OF APPLICATION.

1. Apply traction bands of adhesive plaster or glued strips, one to the dorsal surface and one to the palmar surface of the forearm.

2. Place ring of splint over uninjured arm or posterior half of modification in axilla of uninjured arm. Short rod of splint anterior, long rod of splint posterior.

3. Rods bent to conform to outlines of back and anterior thorax, and passed over head of patient extending across trunk and outward in direction of the abducted injured arm.

4. Shoulder straps and thoracic swathe. Purpose being to maintain position of splint and furnish counter-pressure for traction. Padded webbing strap or soft bandage material fixed to anterior rod near ring, or half-ring, passing over uninjured shoulder about posterior rod, returning over uninjured shoulder close to root of neck, on uninjured side beneath anterior rod, returning over shoulder of injured side close to root of neck to be fastened to pos-

terior rod or brought across again to anterior rod. Swathe 4 to 5 inches wide, or soft bandage material in several thicknesses fastened to ring of splint at junction of ring and anterior rod, passes about thorax and below axilla of injured side to be fastened to ring below junction with posterior rod. The splint is now in position (see page 141, Fig. 27), and traction to the injured arm may be applied by means of traction straps and wood or nail twister, as described in Part I., Chapter I., page 4. Support arm at appropriate points by cross slings snapped (see letter clip, page 159, Fig. 36), or pinned around the rods of the splint.

Uses: The splint is useful for immobilisation of the injured shoulder with traction in an abducted position with the elbow extended. The patient should be recumbent, or the splint supported in a sitting position on account of the weight of the splint. *Very limited ambulation is, however, possible.*

B. Adaptation of two Thomas Traction Arm Splints.

Patient ambulatory or recumbent.

(See illustrations and application, page 143, Fig. 28).

Position of Fixation.—Arm in abduction of 90 degrees.

DESCRIPTION OF APPLICATION.

1. Apply traction bands of adhesive plaster or glued strips to the forearm, palmar and dorsal surfaces.

2. Splint No. 1, shoulder splint, bend rods as in Fig. 28 on page 143.

Bend distal 2 inches of rods downwards at right angle to proximal portion of rods. Place ring of Thomas arm splint over uninjured arm. Retain with shoulder strap and thoracic swathe as in use of Thomas leg splint for injury of shoulder girdle and upper one-third of humerus (see above).

3. Splint No. 2, pelvic splint, bend rods as in Fig. 28, on page 143.

(*a*) Bend ring of Thomas arm splint No. 2 downward towards the rods so that not less than a 2-inch drop is gained as measured on a perpendicular rising from the centre of each half-ring to a line passing across the top of the ring from one rod to the other. This may be done with the aid of two monkey wrenches, or by hand by laying the two rods on the top of an iron bar—*e.g.,* the foot of the bed with the ring close against the further side of the bar—the left hand seizes the lower half of the ring, the right foot is placed against the iron bar, the right hand seizes the upper half of the ring, and by a combined muscular pull of the right arm and a push of the right leg the upper half of the ring is bent downward. The splint is then turned over, and what was the lower half of the ring is bent towards the rod in the same manner. The purpose of this bend of the ring is to secure a well-fitting pelvic prop from which splint No. 1 is supported.

(*b*) The uprights of splint No. 2, called the pelvic splint, are bent near the ring upwards, so that, when the bent and fitted ring is snugly placed against the pelvis, the upper half immediately above the iliac

crest and the lower half immediately above the trochanter, the uprights form the hypotenuse of a right angle triangle whose two other sides are formed—(1) by the line of the body, and (2) by the line of the outstretched abducted arm. At this point the rods of the pelvic splint are bent downward until they are level with and parallel to the Thomas arm splint No. 1, called the *shoulder splint.*

4. The two splints are then fastened together as they cross by adhesive plaster or fine wire No. 3 (see Part III., Chapter II., page 63).

5. Perineal and pelvic straps. The pelvic splint is retained in position and approximated to the body by two long padded webbing straps.

(*a*) The middle of one strap, the perineal strap, is passed around the posterior rod of the pelvic splint from above downward. The two portions are then brought forward together between the legs and the buckle end passed from below upward around the anterior rod of the pelvic splint. The strap is then buckled.

(*b*) The middle of the other strap, the pelvic strap, is passed around the posterior rod of the pelvic splint from below upwards, the two portions are then brought forward together above the iliac crest of the uninjured side and the buckle end passed from above downward around the anterior rod of the pelvic splint. The strap is then buckled.

The splint is now in position, see page 143, Fig. 28, and traction to the injured arm may be applied by means of traction straps and twister, as

described in Part I., Chapter I., page 4. The position of the hand should be midway between pronation and supination, except in fractures of the forearm, when it should be more supinated. It will be noted that the point for traction is the distal end of the pelvic splint. Support arm at appropriate points by slings snapped (see letter clip, page 159, Fig. 36) or pinned around the rods of the splint. The splint may be worn comfortably in recumbency, or in a sitting posture in bed with occasional attention to the perineal and pelvic straps. It is especially designed for ambulatory use, and has proved comfortable and efficient.

C. Combination of one Thomas Traction Arm Splint (Shoulder Splint) and one Jones Humerus Traction Splint, (Pelvic Splint), (see illustration and application, pages 147 and 149, Figs. 30 and 31).

Patient ambulatory or recumbent.

Position of Fixation.—Arm in abduction of 90 degrees, elbow flexed.

DESCRIPTION OF APPLICATION.

1. Apply traction bands of adhesive plaster or glued strips to *upper arm.*

2. Thomas arm splint No. 1 (shoulder splint). Apply as shoulder splint under B (Combination of two Thomas arm splints, page 143, Fig. 28).

3. Jones humerus traction splint, splint No. 2, pelvic splint. Use in the combination a left side Jones humerus splint for a right-sided injury, and *vice versa.* Pad unpadded portion of upper right angle ring of Jones humerus

traction splint and make angle between half rings slightly more obtuse for better pelvic fit.

4. With hands stretch apart the lower ends of the rods near the indentation for traction strips until the rods are at least 4 inches apart.

5. Turn splint upside-down.

6. Place padded axillary crutch immediately above crest of ilium and padded wire half ring immediately above trochanter. Fix to pelvis by padded perineal and pelvic straps and buckles, as in pelvic splint, under combination of two Thomas arm splints. (See page 34, B5.)

7. At the points where the two humeral rods of the pelvic splint cross the posterior rod of the shoulder splint the two sets of rods are fastened together with adhesive plaster or fine wire. At this point the rods of the pelvic splint are bent slightly backwards on themselves and the indented ends (*not used* in this combination for traction) are widened out to allow the upper arm and elbow to pass easily beneath them while the forearm rests on the bottom, as it is ordinarily used, of the forearm band of the Jones humerus traction splint.

Outward rotation of the arm to any degree in the abducted position, which is so often desirable, may be secured easily by bending the forearm portion of the pelvic splint upward.

It will be noted that only the posterior rod of the shoulder splint is fastened by adhesive plaster or wire to the pelvic splint. By a more considerable bending, the nature of which will appear from the illustration, four

points of contact may be secured, but have been found to be usually unnecessary.

The splint is now in position, see page 147, Fig. 30, and traction to the injured arm may be applied by means of traction straps fastened to the upper arm and knotted around the distal indentation or notch of the shoulder splint. The nail or wood twister is then inserted.

The arm is supported at appropriate points by means of slings snapped or pinned around the rods of the splint.

This combination splint may be worn comfortably in recumbency or in a sitting position in bed, with occasional attention to the perineal and pelvic straps. It is especially designed for ambulatory use. The position of abduction of the arm, flexion of the elbow, and control of rotation of the upper arm in an abducted position may be well maintained by this combination.

D. Treatment of Lesions of the Shoulder Girdle and Upper One-third of the Humerus by means of Balkan or Maddox Frame, Traction Straps, Pulleys, and Counterweights.

Patient semi-recumbent.

(See illustrations of apparatus and application, pages 139 and 167, Figs. 26 and 40.)

Symmetrically arranged apparatus for right and left sides of body.

Position of Fixation.—Arm in abduction of about 90 degrees. Elbow flexed or straight, depending upon best alignment of fragments in particular case.

Detail of apparatus best acquired by study of cuts. Approximate traction weight and counter weight advised varies from 3 to 4 pounds for

1. Compound injury to shoulder joint without serious fracture,
2. Fracture of anatomical or surgical neck of humerus,
3. Fracture of upper one-third of shaft of humerus.

2. Injuries of the humeral shaft, elbow and forearm.

Position of Fixation.—Arm in abduction of 90 degrees, elbow extended or flexed.

A. Thomas Traction Arm Splint.

Patient recumbent.

(See illustrations and application, page 99, Fig. 6.)

Position of Fixation.—Arm in abduction of 90 degrees, hand midway between pronation and supination, except in fractures of the forearm, where hand should be more supinated.

DESCRIPTION OF APPLICATION.

1. Apply traction of adhesive plaster or glued strips, one on dorsal surface, one on palmar surface of forearm.
2. Pass ring of Thomas traction arm splint over injured arm.
3. Support arm at appropriate points by means of slings snapped or pinned around the rods of the splint.

The distal end of the splint must rest on a fixed point—*e.g.,* a bed table at the side of the bed, or it may be suspended from a point overhead—*e.g.,* to the Balkan or Maddox frame.

Uses: (*a*) Where Balkan frames are not available.
(*b*) When the condition of the patient, as to temperature, etc., does not allow him to be up.

B. Hinged Modification of the Thomas Arm Splint.

Patient recumbent or semi-recumbent.
(See illustrations and application, page 101, Fig. 7.)

Position of Fixation.—Arm in abduction of variable degrees, hand midway between pronation and supination, except in fractures of forearm where hand should be more supinated.

DESCRIPTION OF APPLICATION.

1. See text above under Thomas Traction Arm Splint.

Uses: The purpose of the modification is to allow some free motion at the shoulder joint without changing the amount of counter-pressure exerted by different positions of the shoulder ring. The patient, therefore, has greater freedom of movement in bed.

We have mentioned in the previous section its advantages in the way of ease of transportation for patient.

C. Combination of two Thomas Traction Arm Splints.

Patient ambulatory or recumbent.

(See illustrations and application, page 145, Fig. 29.)

Position of Fixation.—Arm in abduction of 90 degrees, hand halfway between pronation and supination, except in fractures of forearm, where hand should be more supinated.

The same combination and method of application as in the combination of two Thomas traction arm splints for lesions of the shoulder girdle and upper one-third of the humerus (see page 32, under **B**). If there are no wounds about the shoulder and it is desirable to have the thorax free from apparatus, apply as follows:—

DESCRIPTION OF APPLICATION.

1. Apply traction bands of adhesive plaster or glued strips to the forearm.

2. Splint No. 1, shoulder splint; no bending of this splint is necessary except possibly spreading it at some points to allow space for dressings.

3. Splint No. 2, pelvic splint; bend ring and rods exactly as in combination of two Thomas traction arm splints under lesions of the shoulder girdle and upper one-third of the humerus, description of which should be read (see page 33, under *b*). In addition bend distal 4 inches downward at right angle to rods. Apply and fasten to splint No. 1, shoulder splint, in same manner.

Traction applied by means of traction straps and twister to end of splint No. 1, shoulder splint. Position of hand midway between pronation and supination, except in fractures of the forearm, where hand should be more supinated. Support arm at appropriate points by slings snapped or pinned around the rods of the splint.

The splint may be worn comfortably in recumbency or in a sitting position in bed with occasional attention to the perineal and pelvic straps. It is especially designed for ambulatory use and has proved comfortable and efficient.

D. Combination of one Thomas Traction Arm Splint (Shoulder Splint) and Jones Humerus Traction Splint (Pelvic Splint).

Patient ambulatory or recumbent.

(See illustration of splints and application, page 149, Fig. 31.)

Right hand Jones splint for left side, left hand Jones splint for right side.

Position of Fixation.—Arm in abduction of 90 degrees, elbow flexed.

DESCRIPTION OF APPLICATION.

Apply exactly as same combination for injury of the shoulder girdle and upper one-third of humerus (see page 35, under **C**).

If it is desirable to have the thorax free from apparatus the Thomas traction arm splint ring may be passed over injured arm. The counter pressure is in this case transmitted by the ring against the thorax on the injured side.

E. Lateral Traction Weight and Overhead Counterweight Suspension by means of Balkan Frame or Maddox Tubes and Clamps.

Patient is in bed, but has the possibility of recumbency or freedom of movement to sitting position.

(See pages 139 and 167, Figs. 26 and 40, for application of apparatus.)

Symmetrical arrangement for right and left side of body.

DESCRIPTION OF APPARATUS.

The best idea of the apparatus and methods of arrangement can be had by a study of the illustration.

Uses: The freedom of movement greatly increases the patient's comfort.

F. Plaster of Paris Bridge Splints.

Patient usually ambulatory.

(See illustration and application, page 151, Fig. 32.)

Position of Fixation.—Arm at side in ambulation, may be abducted in recumbency. Elbow usually flexed.

DESCRIPTION OF APPLICATION.

1. Thoroughly cleanse limb, soap, water and alcohol.
2. Apply only the smallest possible dressing over wounds.
3. Apply two pieces of waterproof cloth "Jackinette" (see list of materials supplied, page 61) around limb at level of wound, waterproof side next to skin. Edges slightly overlap at centre of wound and strips are cut wide

enough to extend up and down the arm 4 or 5 inches above and below upper and lower margins of the wound.

4. Apply stockinette over whole limb, padding bony prominences with sheet wadding, or apply thin layer of sheet wadding padding over the whole limb.

5. Estimate length, elevation, and shape of bridges to span wound, and cut single or double thickness of wire mesh 2 or 3 inches longer than length of bridge and usually 1 to 2 inches wide.

6. Spread plaster bandage in successive super-imposed layers out on flat surface 4 inches longer than wire mesh strip.

7. Lay wire mesh strip flat on layers of plaster bandage which extend beyond wire mesh strips 2 inches at either end.

8. Fold layers of plaster bandage around wire mesh strip and spread overlapping ends cut into fan shape.

9. Shape plaster-covered wire mesh with fan ends to previously determined shape of bridge. Lay shaped bridges to one side.

10. Apply 2 or 3 thicknesses of wet plaster of Paris bandage in circular turns to the limb. Great care should be exercised in having an absolutely smooth application next the limb, as soft wrinkles in application become hard ridges in set.

11. Lay on plaster wire mesh shaped bridges over wound making fan-shaped ends conform to contour of limb above and below the wound.

12. Retain in place by more circular turns of wet plaster of Paris

bandage, winding bandage about bridge end as well, forming a "plumber's joint."

13. Cut away plaster and padding beneath bridges and turn back "Jackinette" as cuff. At least 2 inches of skin about margins of wound should be cleared of plaster and padding.

3. Injuries of the Wrist Joint and Hand.

Patient ambulatory or recumbent.

Position of Fixation.—Hyper-extension or dorsal flexion.

A. Jones "Cock-Up" "Crab" Wrist and Hand Splint.

(See illustration and application, page 105, Fig. 9.)

DESCRIPTION OF APPLICATION.

1. Fix forearm piece to palmar surface of forearm by adhesive strips or bandage.

2. Bend wrist rod of splint to any desired angle of dorsal flexion.

3. Shape hand band to fit hand, retain if necessary by adhesive strip or bandage.

4. If it is desirable to completely extend fingers add piece of ladder splint material or make whole splint from ladder splint material.

Uses: All cases of complete or partial wrist drop from *whatever cause.*

B. Plaster of Paris Forearm and Wrist Splint.

For fixation and traction on wrist.

1. Glued cotton glove with buttons and strings sewed to finger tips of hand.

2. Apply several layers of wet plaster of Paris bandage over stockinette or sheet wadding padding to the forearm.

3. Bend ¼-inch wire in form of flat-ended loop to extend several inches beyond distal end of fingers and conform to sides of forearm.

4. Rods placed laterally over pads of felt. Incorporate wire loop, by more circular turns of plaster of Paris forearm bandage, moulding plaster well about end and path of rods.

5. Apply traction by means of finger-tip strings to flat-ended wire loop.

Traction in hyper-extension may be accomplished by bending the wire loop rods dorsally as they emerge from the plaster and applying traction as above to end of loop. Fingers should be moved twice daily, traction meanwhile being maintained manually.

C. Treatment by means of Traction and Overhead Counterweight Suspension in Balkan Frame or Maddox Unit Clamp and Pipe Support.

(See pages 139 and 167, Figs. 26 and 40.)

CHAPTER III

Detailed Descriptions of Splints and Appliances for Lower Extremity.

1. Thomas Traction Leg Splint.

See illustration of splint and application, pages 107 & 109, Figs. 10 & 11.
See description of splint and application, page 13.

2. Hinged Half-Ring Modification of Thomas Traction Leg Splint.

See illustration of splint and application, pages 111 & 169, Figs. 12 & 41.
See description of splint and application, page 14.

3. Anterior Thigh and Leg Splint, Hodgen Type.

See illustration of splint and application, pages 119, 171 & 173, Figs. 16, [42 & 43.
See description of splint and application, page 17.

4. Cabot Posterior Wire Splint.

See illustration of splint and application, pages 121 & 123, Figs. 17 & 18.
See description of splint and application, page 18.

5. Plaster of Paris Bridge Splints.

See illustration of splint and application, page 151, Fig. 32.
See description of splint and application, page 42.

6. Balkan Frame and Maddox Unit Clamps and Tubes for Traction Weight and Overhead Supension.

See illustration, pages 133, 135, 137, 139, 169, 171 and 173, Figs. 23, 24, 25, 26, 41, 42 and 43.
See description of frame and application, pages 27 and 28.

SELECTION OF TYPE OF LOWER EXTREMITY SPLINTS FOR DIFFERENT LESIONS.

1. Injuries to Hip Joint and Neck of Femur.

A. Traction and Counterweight Suspension. Balkan Frame.

Patient recumbent or half sitting. Serious danger of static pneumonia in infected thigh fractures.

(See illustration of frame and patient in position, page 173, Fig. 43.)

Position of Fixation.—Slight flexion, abduction 45 degrees, slight outward rotation. Foot in position of right angle dorsal flexion.

DESCRIPTION OF APPARATUS.

Details best understood from illustration, pages 139 and 173, Figs. 26 and 43. Traction straps fastened to thigh and leg. Limb supported from overhead frame.

B. Plaster of Paris Long Spica with Bridges over Wound.

Position of Fixation.—Slight flexion, abduction 45 degrees, slight outward rotation, and slight knee flexion.

DESCRIPTION OF APPLICATION.

(See page 42 for description of application of plaster bridge splints.)

Patient should be arranged on orthopædic table or Bradford frame with split hammock or transverse straps. Bony prominences, sacrum, spinous processes, and anterior superior spines, knee and malleoli padded with

saddler's felt. *There are many dangers incident to the use of these plaster dressings.*

1. Static pneumonia on account of forced supine position.
2. Pressure sores beneath plaster.
3. Atrophy of muscles.
4. Soiling by wound discharges and excreta.

In spite of these obvious possible disadvantages certain cases may be made extremely comfortable, their lesions heal well, and these dangers may be usually avoided in hands experienced in the use of plaster of Paris.

2. Injuries to the Shaft of the Femur with marked Flexion and Abduction of the Short Upper Fragment.

Anterior Thigh and Leg Splint. Hodgen Type.

Patient recumbent.

Position of Fixation.—Flexion of hip 45 degrees. Abduction up to 30 degrees. Flexion of knee up to 60 degrees. Foot in position of right angle dorsal flexion.

(See illustration of splint, page 119, Fig. 16.)

(See description of splint and application, page 173, Fig. 43.)

Traction may be applied by **Hennequin Band,** see cut. Elevate the foot of the bed. (See illustration, page 157, Fig. 35.) In certain cases the Codivilla (Steinmann) pin is advised.

3. Injuries to the Shaft of the Femur without Flexion and Abduction of the Upper Fragment.

(a) **Thomas Traction Leg Splint.**

(See illustration of splint and application, pages 107 & 109, Figs. 10 & 11.)
(See description of splint and application, page 13.)

(b) **Hinged Half-ring Modification of Thomas Traction Leg Splint.**

(See illustration of splint and application, pages 111 & 169, Figs. 12 & 41.)
(See description of splint and application, page 14.)

Position of Fixation.—Slight flexion at hip, slight abduction 10 degrees plus or minus, alignment anterior superior spine, mid-point of patella, space between second and third toes in the same straight line. Foot dorsally flexed to a right angle.

DESCRIPTION OF APPLICATION.

(See page 109, Fig. 11.)

Suspend splint to bed cradle by wire loop ⅛-inch wire or overhead suspension frame. Keep traction bands continuously tight with nail or wood twister.

(c) **Hinged Half-ring Modification of Thomas Traction Leg Splint used as Anterior Splint, like Hodgen Anterior Thigh Splint, with weight traction and counterbalance suspension or Hodgen Splint.**

(See illustration of apparatus and application, page 171, Fig. 42.)

Position of Fixation.—(1) Slight flexion at hip; (2) slight abduction, 10 degrees plus or minus; (3) knee slightly flexed; (4) anterior superior spine, mid-point of patella, space between second and third toe in the same straight line; (5) foot dorsally flexed at right angle.

DESCRIPTION OF APPLICATION.

1. Apply traction straps to lower leg external and internal surfaces by either applying diachylon plaster, glued strips, or glued sock with sole piece and cords.

2. Turn padded posterior ischial band by means of joint on rods as if it were to fit a left leg as a posterior band when applying it to the right leg.

3. Bend rods of splint very slightly at the knee.

4. Suspend leg from splint by means of slings snapped, or pinned, to rods of splint at appropriate levels.

5. Suspend splint a few inches above the knee and at distal end by cords running over pulleys attached to overhead frame directly above lower leg.

6. Maintain position of splint on leg by running cords attached to upper portion (see page 171, Fig. 42) over pulley fastened to overhead cross bar of frame at head of bed.

7. Insert spreader between traction bands below sole of foot—if sock and ladder splint used no spreader is necessary—and apply weight, canvas basket and shot bag about 22 to 26 pounds.

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8. Right angle dorsal flexion of the foot is maintained by

(1) a piece of compress cloth of flannelette glued over sole of foot extending 2 inches beyond the toes and fastened to rope running over pulley (see illustration) to overhead frame at appropriate point;

(2) by adjustment of the cord in the sock and wire ladder traction appliance (see illustration, page 93, Fig. 3).

4. Injuries to the shaft of the femur with backward displacement of the lower fragment.

Thomas Leg Traction Splint or Hinged Half-ring Modification. Splint applied to posterior surface of limb (see illustration of splint and application, page 109, Fig. 11).

Identical splints for right and left sides of body.

Position of Fixation.—Hip slightly flexed and abducted, knee straight, anterior superior spine, mid-point of patella and space between second and third toes in same straight line. Foot dorsally flexed to right angle.

DESCRIPTION OF SPLINT AND APPLICATION.

(See pages 13 and 14, and page 109, Fig. 11.)

The common malposition is backward displacement of proximal end of lower fragment. Wounds may be allowed to heal and partial union take place, then position may be corrected by manipulation and fixed dressing—*e.g.*, anterior thigh and leg splint, Hodgen type traction and overhead suspension.

Where location and condition of wound will allow most perfect control of position may be secured by means of a long metal pin known as the Codivilla (Steinmann) pin passed through the femoral condyles; to its protruding ends traction is directly applied by means of weights and pulleys.

5. Injuries to the knee joint.

Thomas Traction Leg Splint or Hinged Half-ring Modification. Splint applied to posterior surface of limb.

Identical splints for right and left sides of the body.

Position of Fixation.—Slight flexion of knee, anterior superior spine, mid-point of patella and space between second and third toes in same straight line. Foot dorsally flexed to a right angle, splint suspended to bed cradle, or Balkan frame, or Maddox tube and clamp frame.

DESCRIPTION OF SPLINT AND APPLICATION.

(See pages 13 and 14, and page 109, Fig. 11.)

Plaster of Paris Bridge Splints (see description and illustration, page 42, and page 151, Fig. 32.)

6. Injuries to tibia or both bones of the lower leg.

(See injuries to the knee joint.)

The compound injuries to the knee and leg comprise some of the most serious of battle casualties. The most perfect fixation and traction should be provided for these cases.

7. Fracture of shaft of fibula.

(1) Thomas Traction Leg Splint or Hinged Half-ring Modification (see under injuries to knee, page 52).

(2) Cabot Posterior Wire Splint, Posterior and Side Splints, when conditions of wound will allow its use. Identical splints for right and left sides of the body.

(See illustration of splint and application, pages 121 and 123, Figs. 17 and 18.)

Position of Fixation.—Knee slightly flexed, anterior superior spine, midpoint of patella and space between second and third toes in same straight line. Foot dorsally flexed to a right angle.

DESCRIPTION AND APPLICATION OF SPLINT.

(See pages 121 and 123, Figs. 17 and 18.)

(3) Plaster of Paris Bandages, with Bridges.

(See description of application of bridge plaster of Paris bandage, page 42, and illustration, page 151, Fig. 32.)

8. Injuries near ankle joint and tarsus.

(1) Thomas Traction Leg Splint or Hinged Half-ring Modification.

(See under Injuries of Knee, page 52.)

Glued sock useful for traction.

(2) Cabot Posterior Wire Splint, Posterior and Side Splints.

(See under Injuries to the Shaft of Fibula.)

PART III

PACKETS AND SPECIAL DRESSINGS AND ACCESSORY SUPPLIES.

CHAPTER I

Packets and Special Dressings.

These remarks apply to the dressings of wounds at dressing stations, field hospitals and evacuation hospitals.

It is assumed that the *first-aid* dressings have been applied and that the wounded man is now to have his wounds examined and appropriately dressed for transportation to a base hospital. The object of this dressing is to make it possible to evacuate the patient along the lines of communication with the greatest comfort and the least danger.

This dressing should protect the wounded man from

1. Trauma to his wounds.
2. Loss of blood.
3. Danger of secondary infection.

The surgeon should always use stout rubber gloves when doing dressings. He should cleanse them after each dressing with soap and water and an antiseptic solution. This insures:

1. No transmission of infection from one patient to another.
2. Protection to the surgeon.

I.—Packet No. 1. Red Label.

For Small Wounds.

This packet contains the following supplies, wrapped up in a paper covering that has been dipped in paraffin to protect its contents from moisture. It is marked with two red bands.

On opening the outer covering there will be found:

1. 2 unbleached muslin bandages 4 inches by 5 yards cut on the bias; 2 safety pins 1½ inches long are attached to each bandage.
2. A muslin bag, which opens at one end. This bag contains dressings which are *sterile*. These dressings should be handled with
   Perfect aseptic technic.
   (Sterile forceps or rubber gloves.)

The sterile dressings comprise:

1. 1 toothpick swab wrapped in oiled paper to be used for applying alcohol or iodine.
2. 2 cotton tampons
3. 4 gauze wipes, 4 inches by 4 inches } for cleansing the wound.
4. 1 absorbent pad, 4 inches by 6 inches, attached to a muslin bandage 2 inches by 7 feet long—for final application to the wound.

With these supplies the wound should be dressed and covered and finally

bandaged with one or both of the muslin bandages and firmly pinned with a safety pin.

Dressings of this size should be applied to small wounds.

II.—Packet No. 2. White Label.

For Medium Sized Wounds.

This packet contains the following supplies, wrapped up in a paper covering that has been dipped in paraffin to protect its contents from moisture. It is marked with two white bands.

On opening the outer covering there will be found:

1. 2 unbleached muslin bandages, 5 inches by 5 yards, cut on the bias; 2 safety pins 1½ inches long are attached to each bandage.
2. A muslin bag, which opens at one end. This bag contains dressings which are *sterile*. These dressings should be handled with

   Perfect aseptic technic.

   (Sterile forceps or rubber gloves.)

The sterile dressings comprise:

1. 1 toothpick applicator wrapped in oiled paper to be used for applying alcohol or iodine.
2. 4 cotton tampons.

3. 4 gauze wipes, 4 inches by 4 inches.
4. 1 gauze wick, ½ inch by 8 inches.
5. 1 absorbent pad, 5 inches by 7 inches, attached to a muslin bandage 2 inches by 7 feet long for final application to the wound.

With these supplies the wound should be dressed and covered and finally bandaged with the bandages and firmly pinned.

Dressings of this size should be applied to medium size wounds.

III.—Packet No. 3. Blue Label.

For Large Wounds.

This packet contains the following supplies, wrapped in a paper covering that has been dipped in paraffin to protect its contents from moisture. It is marked with two blue bands.

On opening the outer covering there will be found:

1. 2 unbleached muslin bandages, 6 inches by 5 yards, cut on the bias; two safety pins, 1½ inches long, are attached to each bandage.
2. A muslin bag which opens at one end. This bag contains dressings which are *sterile*. These dressings should be handled with

Perfect aseptic technic.

(Sterile forceps or rubber gloves.)

The sterile dressings comprise:

1. One toothpick applicator wrapped in oiled paper to be used for applying alcohol or iodine.
2. Six cotton tampons.
3. Six gauze wipes, 3 by 7 inches.
4. Two gauze wicks, 1 by 15 inches.
5. One absorbent pad, 11 by 12 inches, attached to a muslin bandage, 4 inches by 7 feet long, for final application to the wound.

With these supplies the wound should be dressed and covered, and finally bandaged with the bandages and firmly pinned.

Dressings of this size should be applied to large wounds.

DRESSINGS, SUPPLIES, AND APPLIANCES.

To be used at Field hospitals and Evacuation hospitals in preparation of wounded for transportation to base hospital.

1. The Gauze Roll.

This dressing is made of one piece of gauze 30 inches wide, 5 yards long, folded to a width of 4½ inches and rolled into bandage form 5 yards long—2 in a pack.

Uses: (1) In abdominal operations as padding or packing.
(2) As a pack to stop hæmorrhage.
(3) As a sterile bandage for multiple wounds.

2. Sponges.

Two sizes of sponges or wipes to be kept on hand *sterilised.*

Small size.—Cut gauze 9 inches by 16 inches and fold to 2 inches by 2¼ inches—25 in a package.

Large size.—Cut gauze 12 inches by 18 inches and fold to 4 inches by 4½ inches—25 in a package.

3. Sterile Dressing Pads.

One size cut 16 by 16 inches and folded 8 by 4 inches—25 in a package, to be kept on hand *sterilised,* and to be used next to wounds as sterile compress.

4. Unsterile Dressing Pads.

Two types, two sizes.

Uses: (1) To protect inside sterile dressing.
(2) To absorb excessive secretion or antiseptic solution.
(3) To protect wound from trauma.

Type 1.—Size 1.—8 by 12 inches, ½ absorbent cotton, ½ non-absorbent cotton, covered with gauze.

Size 2.—14 by 20 inches, ½ absorbent cotton, ½ non-absorbent cotton, covered with gauze.

Type 2.—Size 1.—11½ by 18 inches, ½ absorbent cotton, newspaper back, ½ non-absorbent cotton, newspaper back, covered with gauze.

Size 2.—18 by 23 inches, ½ absorbent cotton, newspaper back, ½ non-absorbent cotton, newspaper back, covered with gauze.

5. Oakum Pads.

Two sizes:

Size 1.— 7 by 11 inches.
Size 2.—14 by 20 inches.

6. Sphagnum Moss Dressing Pads.

Two sizes—for outer absorbent pads:

Size 1.— 7 by 11 inches.
Size 2.—14 by 20 inches.

CHAPTER II

Accessory Supplies.

1. Jackinette.

A form of lightly rubberised muslin.

Uses: As a covering to retain moisture in dressing and to protect dressing. Supplied in rolls.

2. Sheet Wadding or Cotton Batting.

Uses: As protective padding over dressing, and to protect the skin and plaster when plaster of Paris is applied. Supplied in rolls and in bandages, 5 yards by 5 inches.

3. Bandages.

Gauze bandages, 3 inches by 5 yards.

4. Bandages.

Muslin bandages cut on the bias, 4 inches by 5 yards.

5. Bandages.

Muslin bandages cut on the bias, 5 inches by 5 yards.

6. Bandages.

Muslin bandages cut on the bias, 6 inches by 5 yards.

7. Adhesive Plaster.

Uses: For traction straps and for securing dressings in place, supplied in rolls 5 yards by 1 yard.

(*a*) Diachylon plaster—the best form for traction. Heat over flame before applying.

(*b*) Zinc oxide adhesive plaster.

8. Stockinette.

A woven cotton material.

Uses: For a closely fitting covering to protect the skin, especially before the application of plaster of Paris, supplied in three sizes in rolls.

Size No. 1.—3 inches wide, for arms and legs.

Size No. 2.—6 inches wide, for thighs.

Size No. 3.—9 inches wide, for the trunk.

9. Crinoline.

A starch-sized gauze, 35 to 50 threads to the inch.

Uses: To be impregnated with plaster of Paris, and used as plaster of Paris bandages. Supplied in bolts and in bandages 5 inches by 5 yards.

10. Plaster of Paris.

Supplied in bulk and in air-tight containers. *Keep dry.*

11. The Plaster of Paris Bandage.

Made of crinoline gauze (see above) and dry plaster of Paris.

1. With the hand spread plaster over the bandage in only sufficient quantity to completely obscure the meshes of the gauze.

2. Loosely roll bandage so that there is an open space in the centre of roll at least a quarter of an inch in diameter.

3. Wrap rolled bandages in Japanese napkins or absorbent tissue paper, and secure wrapper with rubber bands or thread. Store supply in airtight containers. *Keep dry.* Immerse without removing paper.

12. Felt.

Saddler's felt in rolls.

Uses: To be cut to proper size and used as padding over bony prominences under plaster of Paris bandages or elsewhere where heavy padding is needed.

13. Supporting Slings.

For traction splint—*i.e.,* Thomas leg and arm splint supplied in two shapes, three sizes, made of unbleached muslin or cotton flannel.

Size No. 1.—8 inches by 21 inches, for thighs.

Size No. 2.—5½ inches by 16 inches, for legs and arms.

Size No. 3.—23 inches by 7 inches, the perineal sling used at top of thigh.

Uses: Nos. 1 and 2 are used to support the limb in the splint. No. 3 is used at the top to support the thigh concavity upward.

14. Rubber Cloth Supporting Slings.

Two sizes: 5½ inches by 60 inches, 8 inches by 24 inches. (See page 155, Fig. 34.)

Uses: To be used under wet dressings and discharging wounds.

15. Letter Clips.

Type known as double-lever clip, No. 21. (See page 159, Fig. 36.)
British Patent No. 1,041,402.
U.S.A. Patent February 24th, '03.
Uses: To secure supporting slings to wire rods of Thomas arm and leg splints.

16. Safety Pins.

Two sizes: 2¼ inches and 1½ inches.

17. Straps and Buckles.

Webbing straps and buckles in two sizes.
No. 1, about 1½ inches wide, 3 feet long, buckle attached.
No. 2, about 1½ inches wide, 6 feet long, buckle attached.
Uses: To hold splints in place, to supply straps to pelvic splints in combination arrangement of Thomas arm splints and to replace at times the use of bandages. Can be quickly and easily applied for various uses.

18. Slings.

The triangle sling, one size, 50 by 36 inches, unbleached muslin.

Uses: The triangle sling has a variety of uses and can be applied to retained dressings, support splint and extremities in a number of very efficient ways (see page 161, Fig. 37).

19. The Scultetus Bandage. (See page 163, Fig. 38.)

Made of cotton flannel or flannelette or unbleached muslin, one size, entire length 52 inches, width 12 inches, 4 tails each side, 17 inches long, length of uncut section 18 inches.

Uses: For abdominal bandage or for pelvic bandage. Apply as follows: Grasp left-hand lowest tail with right hand; grasp right-hand lowest tail in left hand; bring left-hand lowest tail obliquely forward and upward over abdomen; bring right-hand lowest tail obliquely upward and forward, crossing left-hand tail; release lowest left-hand tail grasping next above left-hand tail; repeat with successive tails, pinning last right-hand tail with safety pins. Pin crossings of bandage, if necessary.

20. The Many-Tailed Bandage.

To make many-tailed bandage, cut square of unbleached muslin of proper size and from each edge tear toward centre one-third the width of the piece,

making strips 1 inch to 2 inches wide. These can be tied or pinned as with Scultetus bandage.

Uses: To hold in place large dressings, to avoid the necessity of applying a bandage to painful dressings. Applied by tying opposite ends or overlapping, as with Scultetus bandage.

21. The Anklet. (See page 95, Fig. 4.)

An appliance for making traction at the ankle. Made of heavy canvas, with eyelet holes for a lacing string. Two straps are attached laterally for application of traction. In applying this anklet the ankle and dorsum of the foot should be well padded before tightening lacing or applying traction (see sketch).

Uses: To be applied to the ankle when it is desired to exert traction on the lower extremity. It is useful near the Front where the element of time is important. It may be applied over the leather shoe or boot. Traction thus obtained is not as efficient or as comfortable as that secured by adhesive straps or glucd straps or the glued stocking traction.

22. The Elbow Traction Band.

A muslin traction appliance for exerting traction on the arm immediately above the elbow joint.

Uses: To be applied to the lower portion of the upper arm, well padded for making traction on the arm either where the Thomas splint is used, or in recumbency. Adhesive or glued traction appliances are more efficient and more comfortable.

23. The Canvas Hammock.

A canvas hammock, size 20 by 48 inches, with transverse loops, 3 inches wide, at each end, to be used for suspension in application of plaster of Paris jackets and spicas.

24. Canvas Swathes for Use in Connection with Bradford Frames. (See page 127, Fig. 20.)

Heavy canvas, 12 inches wide, 3 feet 6 inches long, with eyelet holes in ends. To be laced about long sides of frame as required for support of patient.

25. Pneumonia Jackets.

A padded cotton jacket, with two armholes tying in front with tape; one size.

26. Heel Rings.

A small pad made like a doughnut of cotton padding, covered with cloth to protect the heel from pressure.

27. Rope.

⅛ inch or 3/16 inch braided rope.

Uses: To apply traction where the Balkan frames or Maddox frames are used.

28. Weights. Fig. 22.

Small canvas bags of shot or lead. Sizes ½ lb. and 1 lb. of shot.
Uses: To supply weight for traction and counterbalance appliances.

29. Bags.

Canvas bags to contain shot bag weights. A heavy canvas bag with an open mouth (see page 131, Fig. 22).

Uses: As a container for shot bag weights in traction pulls and counterbalance appliances.

30. Pulleys.

Iron pulleys, with hook, size 1¼ inch wheel (see page 129, Fig. 21).

Uses: To carry rope in applying traction and counterbalance to apparatus in the treatment of fractures in connection with the Balkan frame and the Maddox frame.

31. Wire.

Three sizes:

No. 1. ¼ inch iron wire in 6-feet lengths.
No. 2. Galvanised iron telephone wire, ⅛ inch, in rolls.
No. 3. Galvanised iron wire, 1/16 inch, on spools.

Uses: No. 1 wire for special splints and in suspension apparatus.
No. 2 wire for special splints and for retaining the position of overlapping wood or metal bars subjected to heavy strain.
No. 3 wire for fastening pulleys to frame and for securing iron rods together in combinations of Thomas splints.

32. Wire Gauze.

Specially made wire gauze rolls, 1 yard long, 6 inches wide, for various uses. This gauze has double selvedge edges and can be cut to any desired length with heavy shears (see page 165, Fig. 39).

Uses: 1. As supporting sling on traction splint where wounds are discharging profusely or where irrigations are used.
2. For making light splints for various uses.
3. For core of plaster bridges.

NOTE.—The cut ends should be covered with adhesive plaster.

33. Wood.

For Balkan frame. Size, 3 inches by 7/8 inch, in 7 feet lengths, strong, soft wood.

34. Iron Pipe.

1 inch galvanised iron pipe, in 7 feet lengths and 3½ feet lengths.

35. Maddox Unit Clamps.

For fastening pipes together in making Bradford frames, suspension apparatus, etc. (see page 135, Fig. 24 (1)).

36. Clamps, Special.

For securing pipe to bed frame (see page 135, Fig. 24 (2)).

37. Strap Iron Hooks.

For attaching pulleys to overhead frames, Balkan and Maddox frames (see page 129, Fig. 21).

38. Tools.

1 Machinist's hammer.
1 screwdriver.
1 tinsmith's shears.
1 wire pliers.
1 wire cutter.
2 monkey wrenches, 2 inch jaws.
1 nut wrench for Maddox frame (see page 135, Fig. 24 (3)).
1 hack saw.
1 oil can.

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PART IV

DESCRIPTIVE ILLUSTRATIONS

Fig. 1

Adhesive Plaster Traction.

1. Method of cutting and folding traction end of adhesive strip.
2. Anterior view of application to leg.
3. Lateral view of application to leg.

Fig. 1

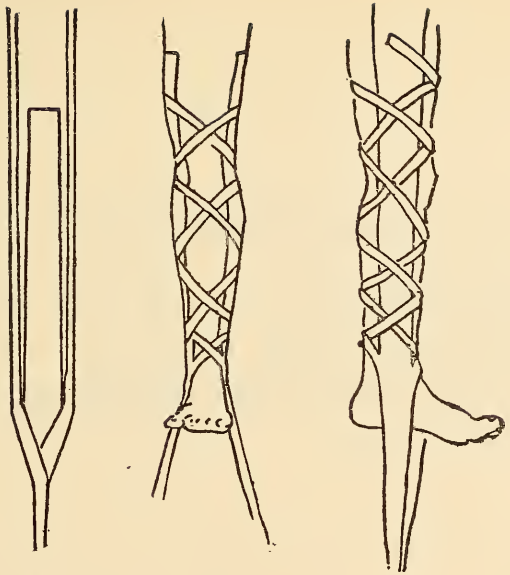


Fig. 2

Nail Twister or Spanish Windlass.

For maintaining constant and easily adjustable tension on traction bands in all forms of traction splints.

Head of nail snapped under or over rod of splint as twist requires.

See description, page 4.

Fig. 2

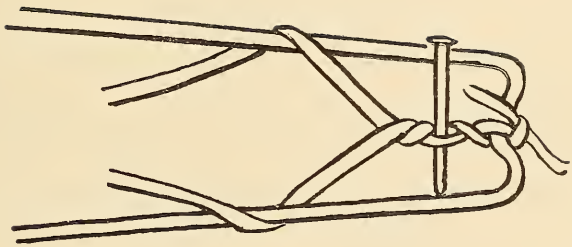


Fig. 3

Stocking Traction.

Light weight sock cut off at toes glued to lower leg, ankle and dorsum of foot.
Piece of splint wood or ladder splint material passed between sock and sole of foot.
Traction by means of cords tied through sock and splint material.

See description, page 5.

Fig. 3

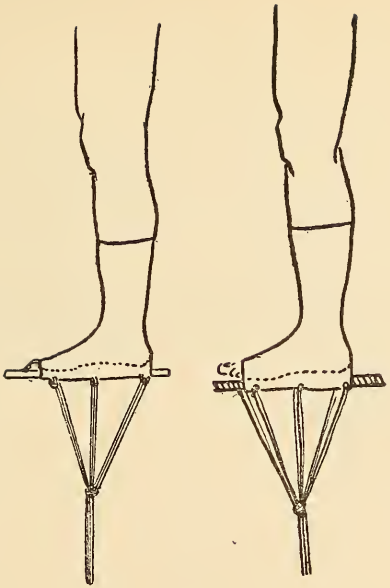


Fig. 4

Canvas Anklet and Traction Bands.

For quick application over boot or heavily padded and bandaged ankle and foot. Chief use at the front for transport in traction leg splint.

See description, page 6.

Fig. 4

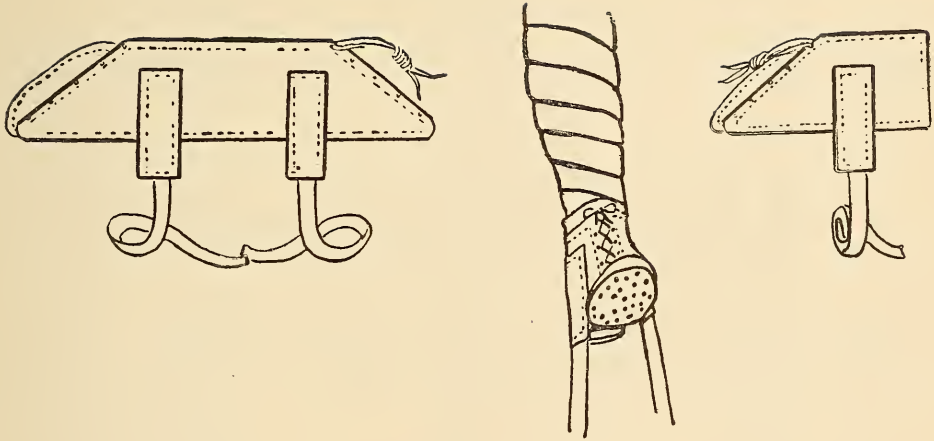


Fig. 5

1. Thomas Traction Arm Splint.

2 and 3. Murray's Modification Hinged Traction Arm Splint.

Uses:—

(*a*) Injuries to the shoulder joint, 1.
(*b*) Injuries to the shaft of the humerus, 1, 2, and 3.
(*c*) Injuries to the elbow joint, 1, 2, and 3.
(*d*) Injuries to the forearm, 1, 2, and 3.

See illustration of splints applied, pages 99 and 101.
See description of splints, pages 7 and 8.

Fig. 5

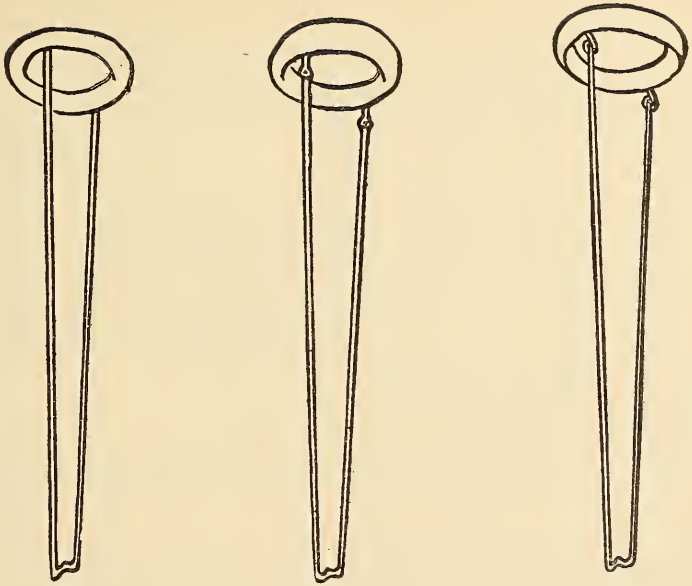


Fig. 6

THOMAS TRACTION ARM SPLINT.

Applied for bed treatment.

Uses:—

(*a*) Injuries to the shoulder joint.
(*b*) Injuries to the shaft of the humerus.
(*c*) Injuries to the elbow joint.
(*d*) Injuries to the forearm.

Note:—Ring well over shoulder.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.
Distal end of splint supported.

See description of splint, page 7.

Fig. 6

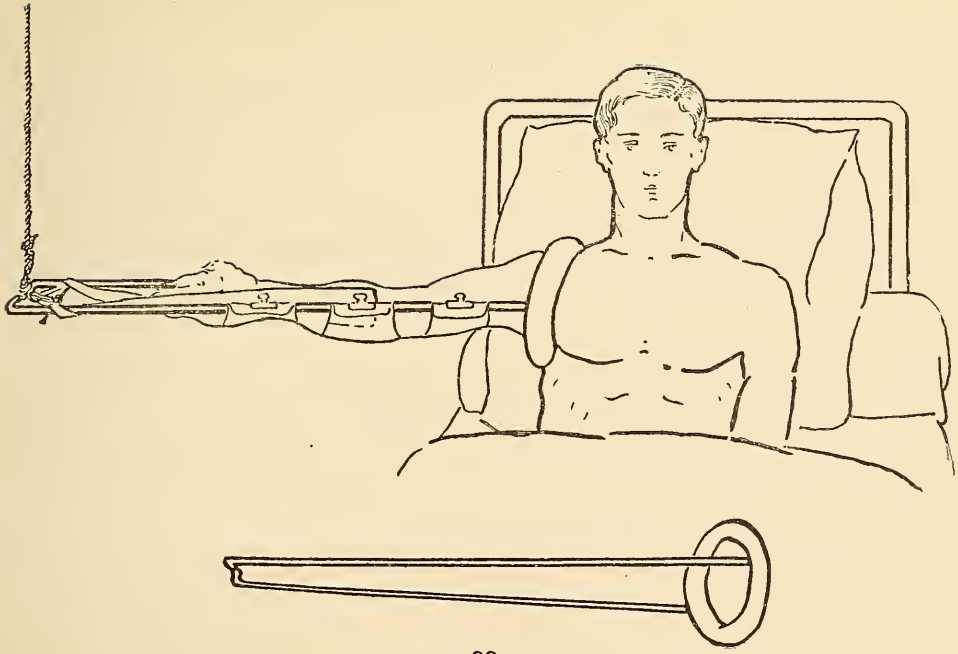


Fig. 7

Hinged Traction Arm Splint.

Applied for Stretcher Transport.

Uses:—

(*a*) Injuries to the shaft of the humerus.
(*b*) Injuries to the elbow joint.
(*c*) Injuries to the forearm.

Note:—Loop hinge at centre of shoulder joint.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.

See description of splint, page 8.

Fig. 7

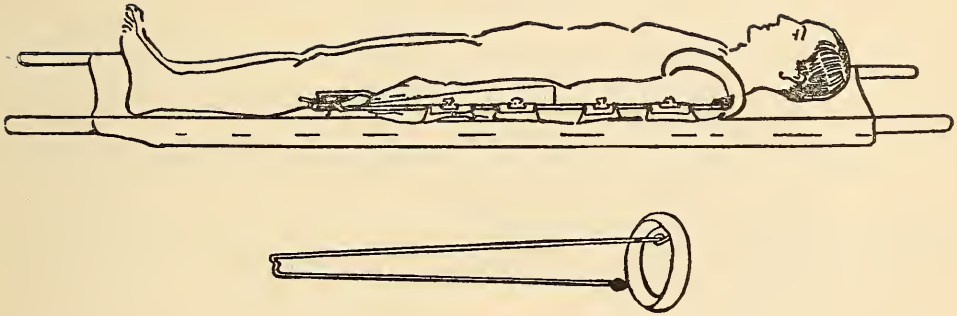


Fig. 8

Jones Humerus Traction Splint and Application.

Uses:—

(*a*) Injuries to the shaft of the humerus, in which traction on the humerus and flexion of the elbow joint are desired.
(*b*) Injuries to the elbow joint in which flexion is desired.
(*c*) Injuries to the forearm.

Note:—Padded axillary crutch.
Extension of rods below elbow for traction.
Traction bands.
Forearm support.

See description of splint, page 9.

Fig. 8

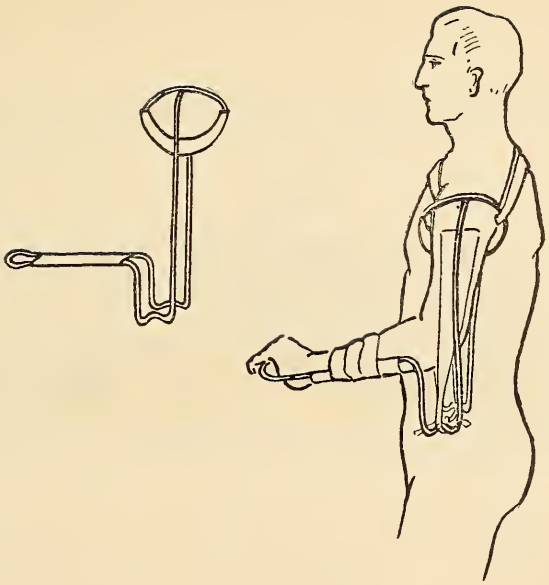


Fig. 9

JONES "COCK-UP" OR "CRAB" WRIST SPLINT AND APPLICATION.

Uses:—

(*a*) To retain the position of dorsal flexion of the hand in cases of injury to the wrist and in nerve and muscle injuries which produce wrist drop.

(*b*) To obtain full extension of fingers add piece of ladder splint material, or use ladder splint material alone.

See description of splint and application, page 10.

Fig. 9

Fig. 10

Thomas Traction Leg Splint.

Uses:—

(*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

See illustration of splint applied, page 109.

See description of splint, page 13.

Fig. 10

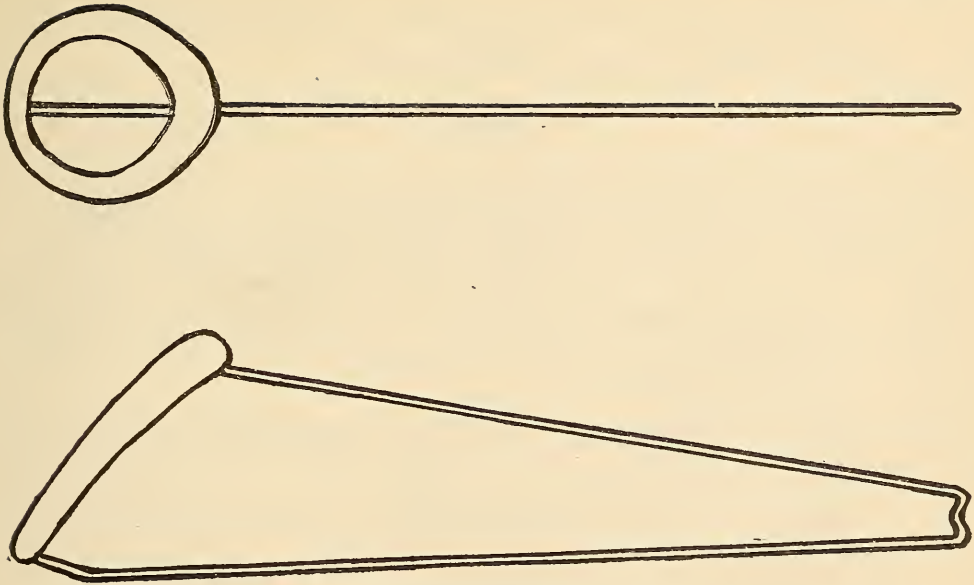


Fig. 11

THOMAS TRACTION LEG SPLINT AND APPLICATION.

Watch skin for signs of pressure sore.

Uses:—

(*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

Note:—Ring hugs ischial tuberosity and ascending ischial ramus.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.
Dorsal flexion of foot at right angle maintained by sole band fastened to bed cradle.
Splint and leg supported from cradle by double hook of wire.

See illustration of splint, page 107.
See description of splint, page 13.

Fig. 11

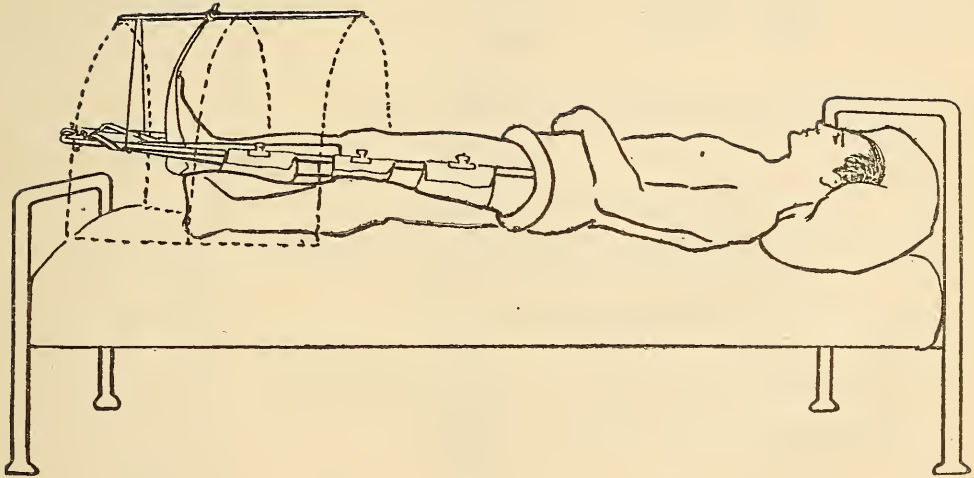


Fig. 12

Hinged Half-Ring Modification of Thomas Traction Leg Splint.

Watch skin for signs of pressure sore.

Uses:—

(*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

See illustration of splint applied, page 113.

See description of splint, page 14.

Fig. 12

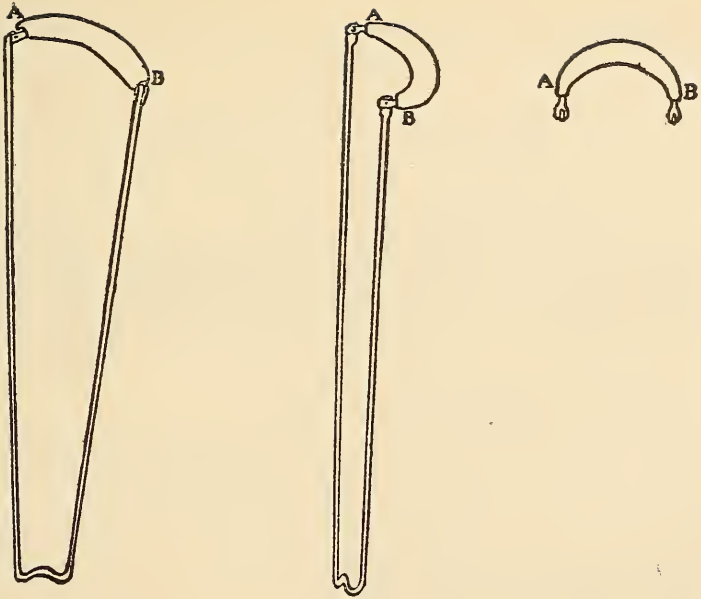


Fig. 13

HINGED HALF-RING MODIFICATION OF THOMAS TRACTION LEG SPLINT.

Applied for stretcher transport.

Uses:—

(*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee joint.
(*d*) Injuries to the leg.

Note:—Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.
Stretcher cradle and supporting double hook.

See illustration of splint, page 111.
See description of splint, page 14.

Fig. 13

Fig. 14

Long Liston Splint with Interrupting Bridge of Iron Wire.

A. Footpiece adjustable to different lengths of leg.
B. Interrupting bridge.
C. Thoracic bar.

See illustration of splint applied, page 117.
See description of splint, page 16.

Fig. 14

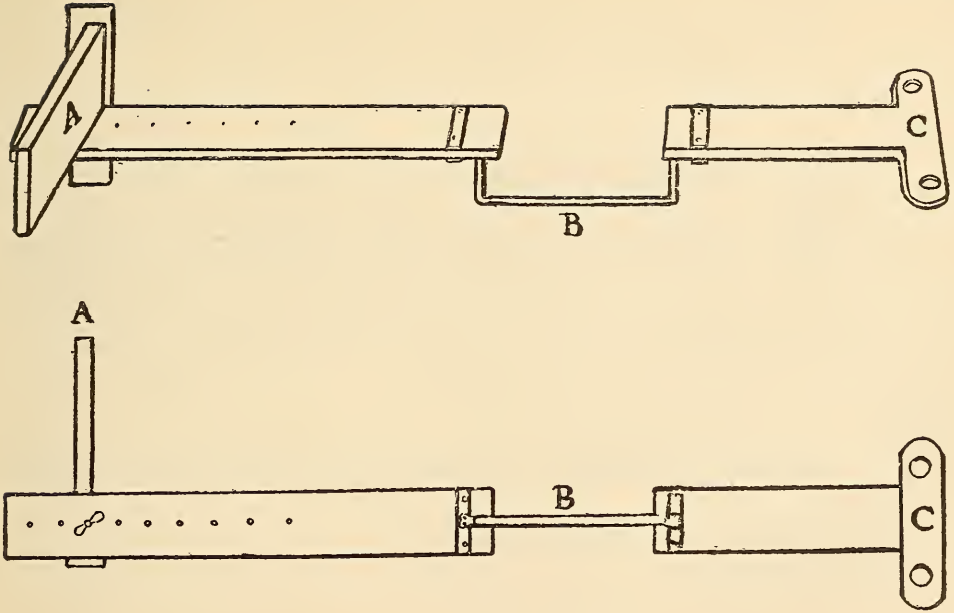


Fig. 15

LONG LISTON SPLINT WITH INTERRUPTING BRIDGE.

Applied for stretcher transport *only*.

Uses:—

(*a*) Multiple injuries to the body and limb requiring fixation for comfortable transport.
(*b*) Injuries to the pelvis requiring fixation in transport.
(*c*) Injuries to hip joint requiring fixation and abducted position in transport.

The upper thigh and hip should be supported in transport by a sandbag or pillow or spica bandage.

Note:—Thoracic and leg bandages.
Bandage passing from thoracic bar over uninjured shoulder.

See illustration of splint, page 115.

See description of splint, page 16.

Fig. 15

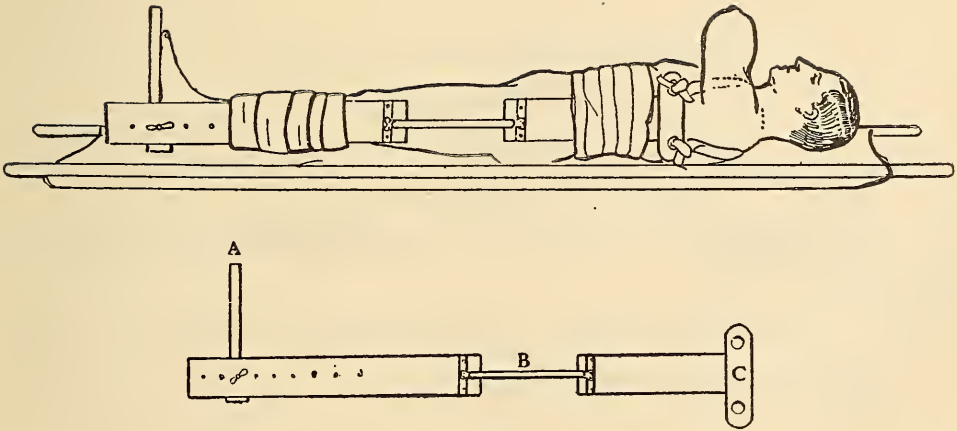


Fig. 16

Anterior Thigh and Leg Splint.
Hodgen Type.

Uses:—

For suspension of the limb from overhead support in injuries to the thigh and leg.

See illustration of splint applied, pages 171 and 173.

See description of splint, page 17.

Fig. 16

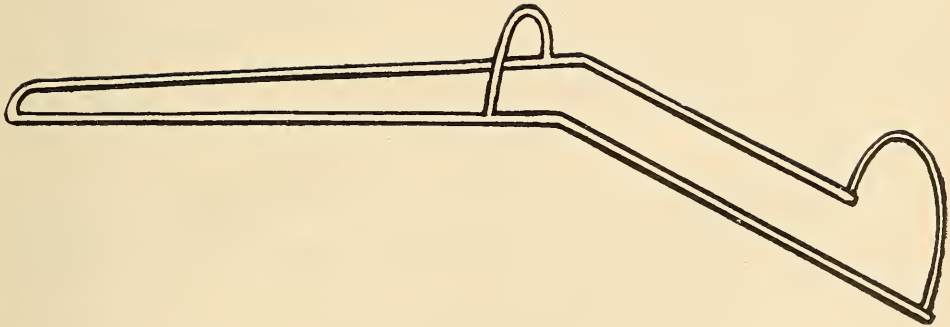


Fig. 17

Cabot Posterior Wire Leg Splint.

To be used with posterior and side splints.

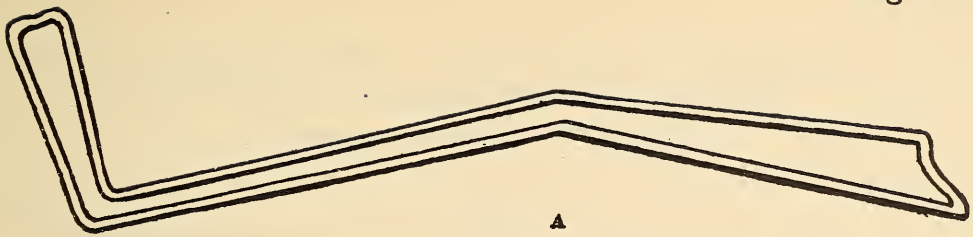
A. Skeleton splint.
B. Bandaged splint ready for application.

Uses:—

(*a*) Injuries to the soft parts of the lower limb requiring fixation in transport.
(*b*) Slight injuries to the knee or ankle requiring fixation in transport.
(*c*) Fractures of the fibula or tarsus.

See illustration of splint applied, page 123.
See description of splint, page 19.

Fig. 17



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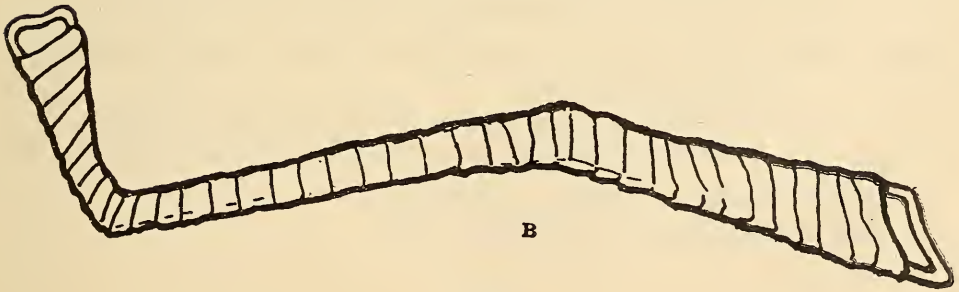


B

Fig. 18

CABOT POSTERIOR WIRE LEG SPLINT, WITH POSTERIOR AND SIDE SPLINTS OF LADDER SPLINTING MATERIAL.

Applied for stretcher transport.

Uses:—

(*a*) Injuries to the soft parts of the lower limb requiring fixation in transport.
(*b*) Slight injuries to the knee or ankle requiring fixation in transport.
(*c*) Fractures of the fibula.

Note:—Side splints and posterior splint of ladder splint material or light splint wood.
A. Adhesive plaster straps retaining Cabot splint.
B. Straps and buckles retaining posterior and side splints.

See illustration of splint, page 121.
See description of splint, page 19.

Fig. 18

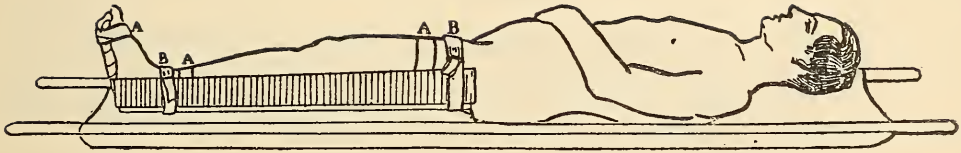


Fig. 19

Ladder Splint Material.

Uses:—

(*a*) For shoulder, upper arm, elbow, forearm, wrist, hand, lower leg, ankle and foot splints.
(*b*) For posterior and side splints in combination with Cabot posterior wire leg splint.
(*c*) For coaptation splints.
(*d*) For various uses where mouldable light splint material is to be desired.

See description, page 22.

Fig. 19

Fig. 20

Bradford Frame and Canvas Swathes.

Uses:—

(*a*) For transport of injuries to spine, pelvis or hip joint.
(*b*) For application of plaster jackets and spicas in connection with canvas, hammock or swathes.

Made of iron pipe and Maddox clamps.

See illustration of Maddox clamps, page 135, fig. 24 (1).
See description of frame, page 24.
See description of Maddox clamps, page 70.
See description of swathe, page 67.

Fig. 20

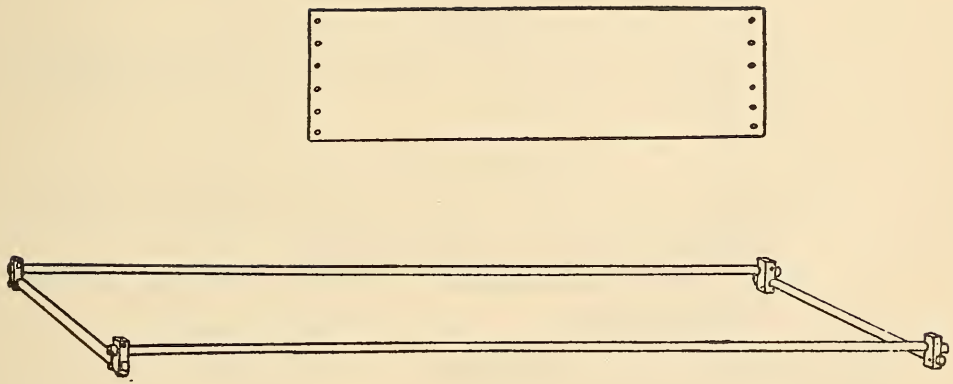


Fig. 21

Pulley and Strap Iron Hook.

Pulley.

For weight and pulley traction or counterweight suspension.

Strap Iron Hook.

For use in connection with wood overhead bed frame or Maddox clamp and pipe supports.
Holes receive pulley hook or screws if desired to fix to overhead frame.

See description, pages 68 and 70.

Fig. 21

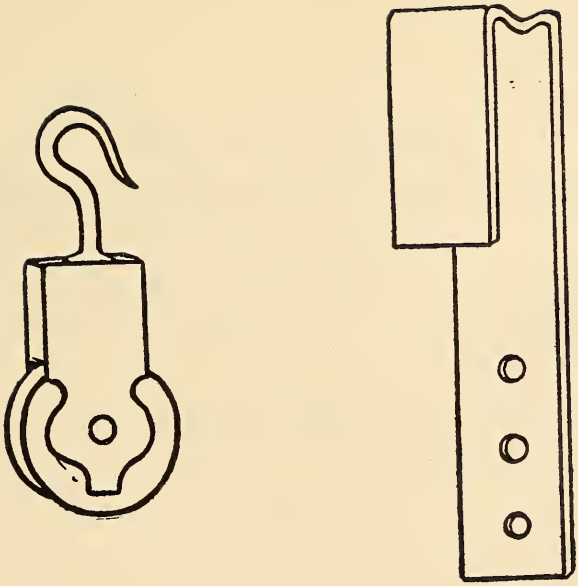


Fig. 22

CANVAS BAG AND WEIGHT.

For weight and pulley traction or weight suspension.

Handle of bag to be fastened to traction cord.
Weights in $\frac{1}{2}$ lb. and 1 lb. bags to be placed in open canvas bag as required.

See illustrations of use, pages 167, 169, 171 and 173.
See description, page 68.

Fig. 22

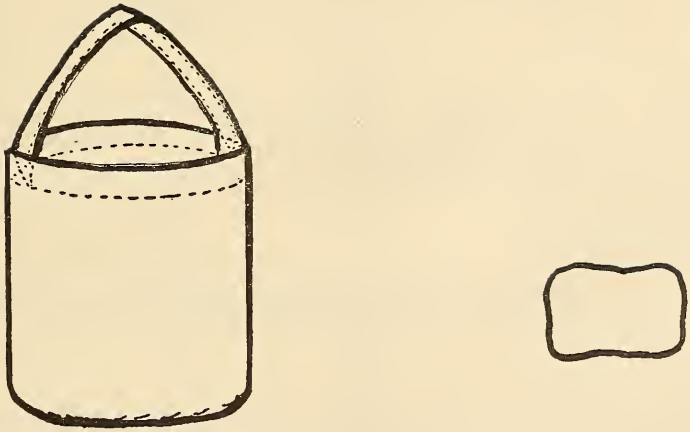


Fig. 23

Wooden Overhead Bed Frame.

Uses:—

For counterweight suspension and treatment by weight and pulley traction.

H.G. = 8′ 8″.
A.B. = 6′ 6″.
E.F. = 3′ 3″.
C.D. = Width of bed placed at level of top of mattress.
B.J. = 3″ wider than bed.

See illustrations of frame in use, pages 167, 169, 171 and 173.
See description of frame, page 27.

Fig. 23

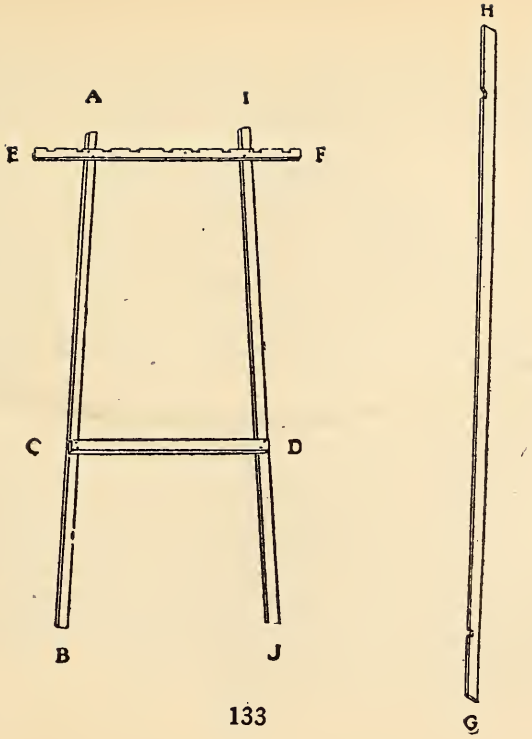


Fig. 24

1. Maddox Unit Clamp.
2. Clamp for Fastening Iron Pipe to Frame of Bed.
3. Wrench for Tightening Nuts of Clamps.

Uses (with iron pipe):—

(*a*) For quick construction of Bradford frames.

(*b*) For construction of overhead supports attached to bed frame, weight and pulley traction and counterweight suspension.

1. Maddox Clamp.—Metal block with two split holes (B) bored at right angles to each other, to receive iron pipe. Pipe held in place by tightening nuts (A).

See illustrations of combinations, pages 25 and 26.

See description of clamps and uses, page 70.

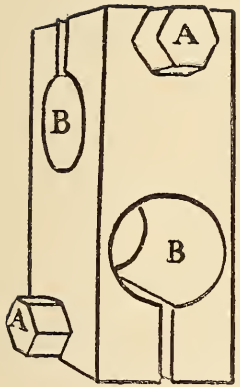
2. Bed clamp.—Hooks (C) passed over vertical or horizontal bar of bed frame. Iron pipe inserted between bar of bed frame and swivelled jaw (D) of clamp. Concavity of jaw fits convexity of pipe.

   By means of nut (A) and screw shaft (E) jaw (D) forced against iron pipe. Two bed clamps necessary to firmly fix iron pipe to bed frame.

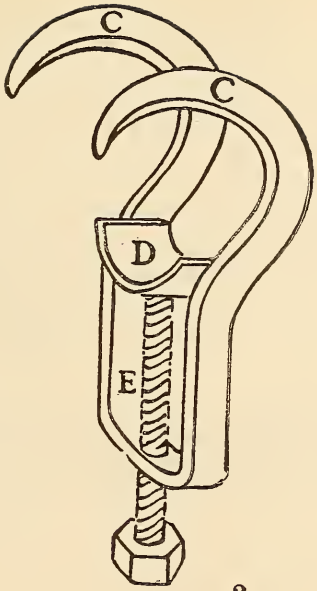
See illustrations of bed clamps applied, pages 137 and 139.

3. Wrench for tightening or loosening nuts (A).

Fig. 24



1



2

3

Fig. 25

MADDOX UNIT CLAMPS, IRON PIPE AND BED FRAME CLAMP.

Applied for simple leg traction by weight and pulley.

A. Maddox clamp.
B. Bed frame clamp.
C. Hook and pulley.

See illustration of clamps, page 135, hook and pulley, page 129.
See description of clamps and uses, page 70.

Fig. 25

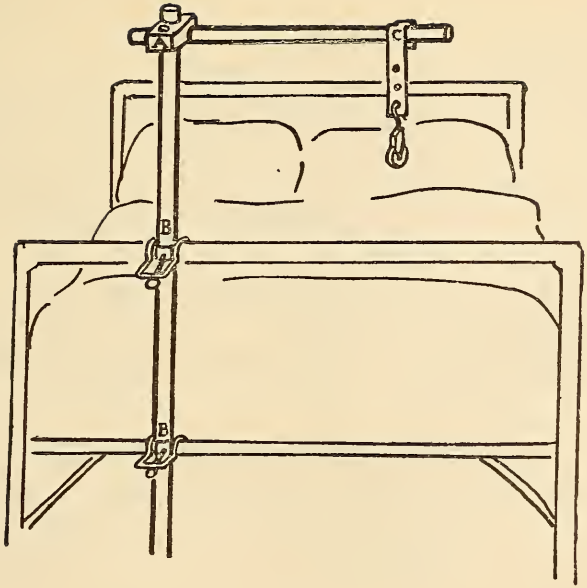


Fig. 26

MADDOX UNIT CLAMPS, IRON PIPE AND BED FRAME CLAMPS.

Applied, in various ways, for suspension and weight and pulley traction.

A. Leg traction in abduction.
B. Leg traction straight.
C. Arm traction in abduction with elbow flexed.

See illustrations of Maddox and bed frame clamps, page 135.
See description of Maddox and bed frame clamps, page 70.

Fig. 26

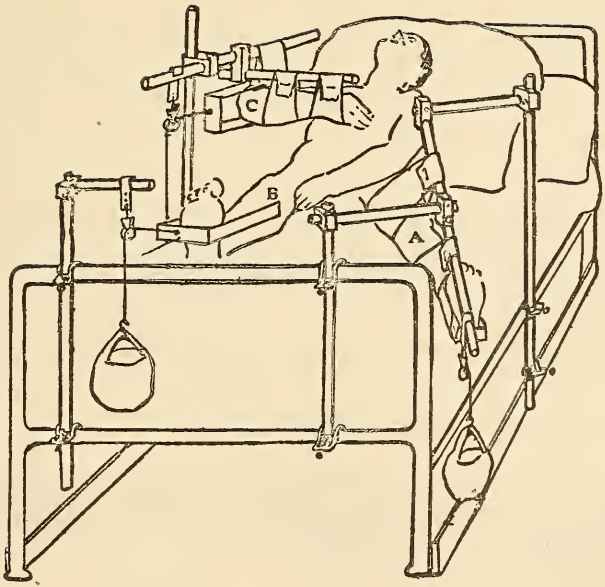


Fig. 27

THOMAS TRACTION LEG SPLINT.

Applied over uninjured shoulder.
For shoulder and arm injuries.

Note:—Shoulder-straps for supporting splint.
Thoracic swathe for counter pressure.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.

See description of application, page 31.

Uses:—

In injuries to the shoulder girdle and upper third of the shaft of the humerus.

Fig. 27

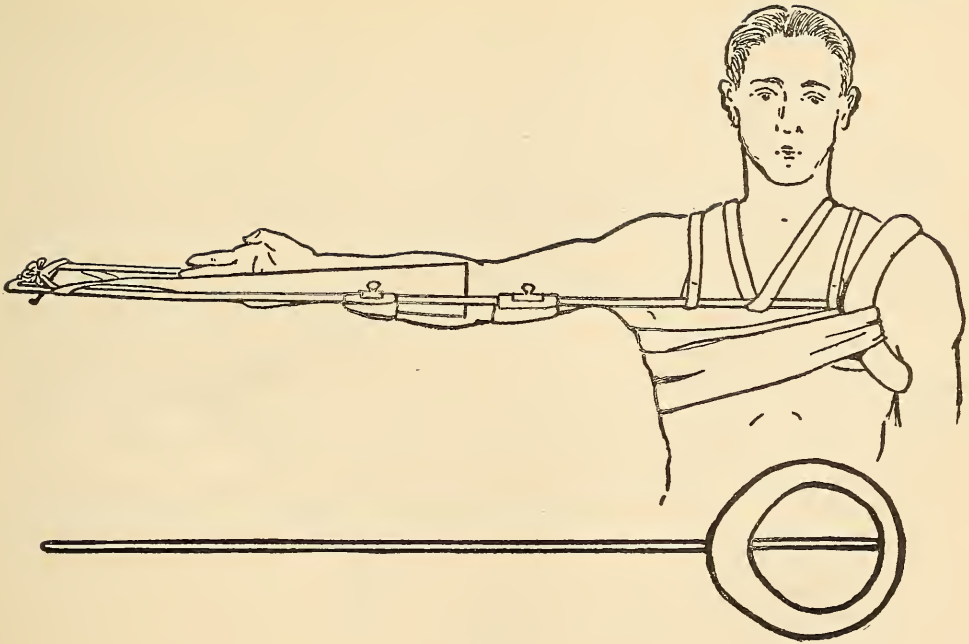


Fig. 28

Adaptation of Two Thomas Traction Arm Splints.

For maintaining abduction of arm and allowing ambulation.
Shoulder splint applied over uninjured shoulder.
In cases of shoulder girdle and axillary wounds.

Uses:—Where it is desirable to maintain abduction of the arm in
(*a*) Injuries to the shoulder girdle,
(*b*) Injuries to the shaft of the humerus,
(*c*) Injuries to the elbow joint,
(*d*) Injuries to the forearm.
Patient may be ambulatory.

Shoulder Splint (applied over uninjured shoulder):—

Note:—Distal two inches of splint bent downward to clear hand.
Shoulder straps.
Thoracic swathe for counter pressure.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.

Pelvic Splint:—

Note:—Ring bent downward toward rods to conform to pelvis, see page 33.
Upper half of ring applied just above crest of ilium.
Lower half of ring applied between trochanter and anterior superior spine.
Rods bent parallel to shoulder splint rods at intersection of two rods.
Parallel portions of two sets of rods fastened together with wire or adhesive plaster.
Padded pelvic and perineal straps.

See description of application, page 32.

Fig. 28

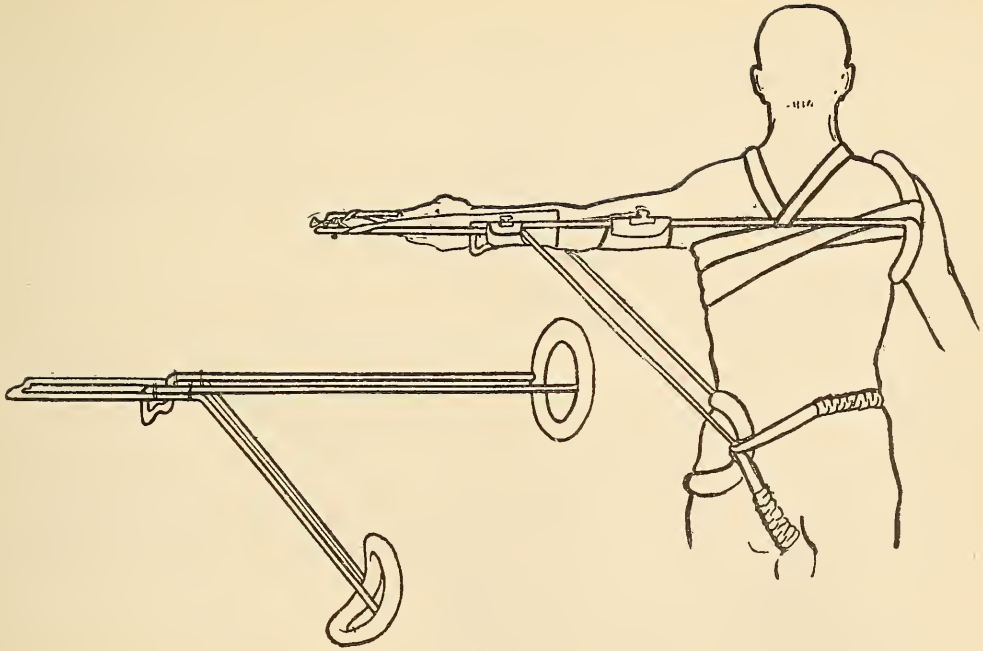


Fig. 29

Adaptation of Two Thomas Traction Arm Splints.

For maintaining abduction of arm and allowing ambulation.

Uses:—Where it is desirable to maintain abduction of the arm in

(*a*) Injuries to the shoulder joint,
(*b*) Injuries to the shaft of the humerus,
(*c*) Injuries to the elbow joint,
(*d*) Injuries to the forearm.

Patient may be ambulatory.

Shoulder Splint:—

Note:—Supporting slings clipped to rods. Traction bands.
Nail twister for maintaining and regulating traction.

Pelvic Splint:—

Note:—Ring bent toward rods to conform to pelvis, see page 33.
Upper half of ring applied just above crest of ilium.
Lower half of ring applied between trochanter and anterior superior spine.
Rods bent parallel to shoulder splint rods at intersection of two splints.
Distal two inches of pelvic splint bent downward to clear traction bands.
Parallel portions of two sets of rods fastened together with wire or adhesive plaster.
Padded pelvic and perineal straps.
See description of application, page 32.

Fig. 29

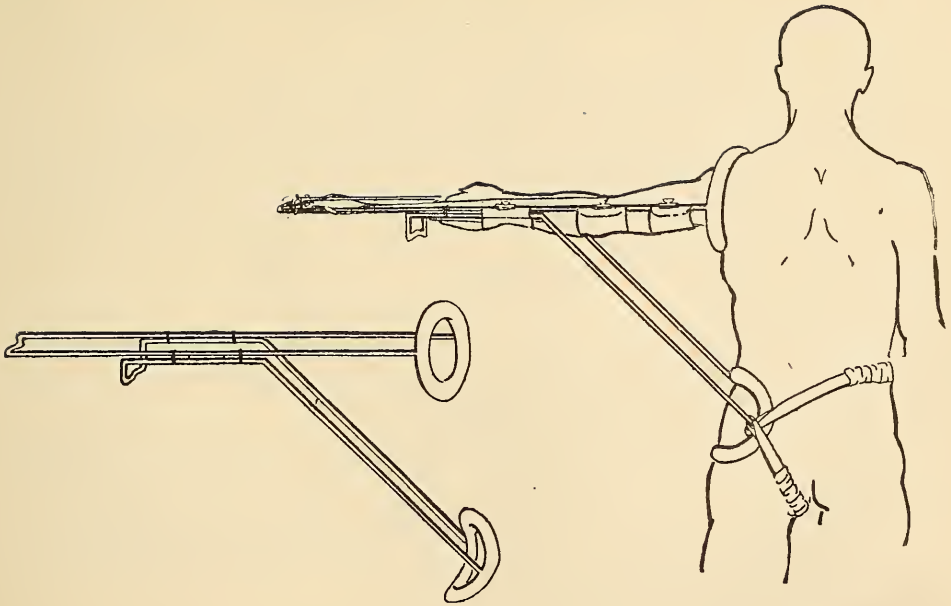


Fig. 30

Adaptation of Thomas Traction Arm Splint and Jones Humerus Traction Splint.

For maintaining abduction of arm with flexion of elbow and control of rotation and allowing ambulation.

Shoulder splint applied over uninjured shoulder.
In cases of shoulder girdle and axillary wounds.

Uses:—Where it is desirable to maintain abduction of the arm in:—

(*a*) Injuries to shoulder joint in which flexion of the elbow is desirable,
(*b*) Injuries to the shaft of the humerus in which flexion of the elbow and control of rotation is desired,
(*c*) Injuries to the elbow joint in which traction on joint is not necessary but flexion is desirable,
(*d*) Injuries to the forearm.

Patient may be ambulatory.

Shoulder Splint (applied over uninjured shoulder):—

Note:—Shoulder straps.
Thoracic swathe for counter pressure.
Supporting slings clipped to rods.
Traction bands.
Nail twister for maintaining and regulating traction.

Pelvic Splint (use right Jones humerus traction splint for left side of body and vice versa):

Note:—Jones humerus traction splint turned upside down.
Unpadded portion of shoulder ring heavily padded.
Widen space between indented ends of upper arm rods.
Bend forearm portion away from upper arm portion of splint to form more obtuse angle.
Upper half of ring applied just above crest of ilium.
Lower half of ring applied between trochanter and anterior superior spine.
At intersection of rods of pelvic splint with posterior rod of shoulder splint, rods fastened together with wire or adhesive plaster.
Padded pelvic and perineal straps.
Rotation of shoulder controlled by bending forearm portion of pelvic splint upward or downward. See description of application, page 35.

Fig. 30

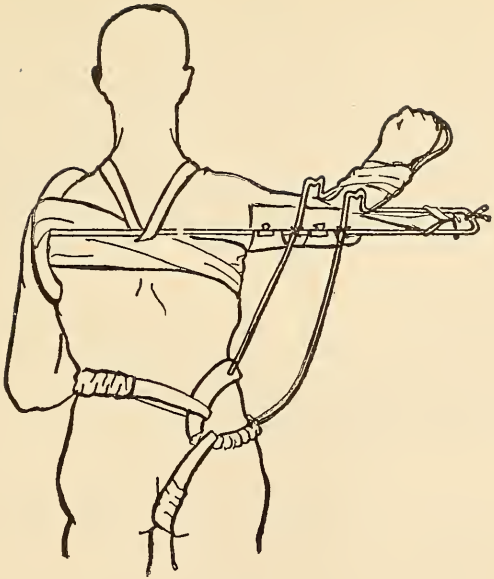


Fig. 31

Adaptation of Thomas Traction Arm Splint and Jones Humerus Traction Splint.

For maintaining abduction of arm with flexion of elbow and control of rotation and allowing ambulation.

Uses:—Where it is desirable to maintain abduction of the arm in:

(*a*) Injuries to shoulder girdle in which flexion of the elbow joint is desirable,

(*b*) Injuries to the shaft of the humerus in which flexion of the elbow and control of rotation is desirable,

(*c*) Injuries to the elbow joint in which traction on joint is not necessary but flexion is desirable,

(*d*) Injuries to the forearm.

Patient may be ambulatory.

Shoulder Splint:—

Note:—Supporting slings clipped to rods.

Traction bands.

Nail twister for maintaining and regulating traction.

Pelvic Splint (use right Jones humerus traction splint for left side of body and vice versa):—

Note:—Jones humerus traction splint turned upside down.

Unpadded portion of shoulder ring heavily padded.

Widen space between indented ends of upper arm rods.

Bend forearm portion away from upper arm portion of splint to form more obtuse angle.

Upper half of ring applied just above crest of ilium.

Lower half of ring applied between trochanter and anterior superior spine.

At intersection of rods of pelvic splint with posterior rod of shoulder splint, rods fastened together with wire or adhesive plaster.

Padded pelvic and perineal straps.

Rotation of shoulder controlled by bending forearm portion of pelvic splint upward or downward. See description of application, page 35.

Fig. 31

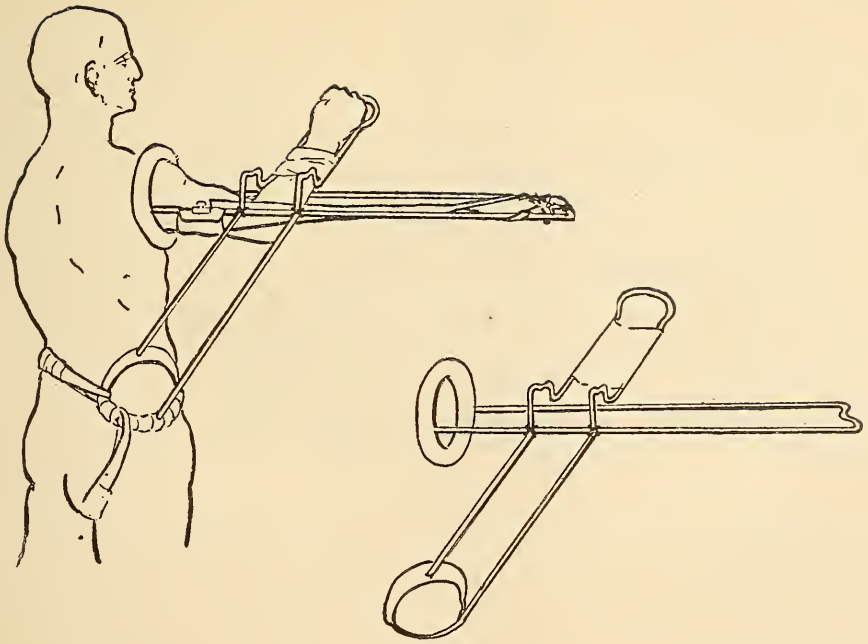


Fig. 32

PLASTER OF PARIS BRIDGE SPLINTS.

A. Cuffs of waterproof material.

B. Bridges of plaster with wire mesh core.

See description of uses and application, page 42.

Fig. 32

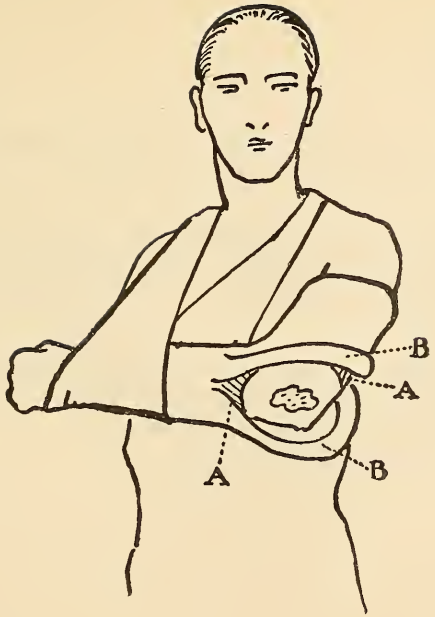


Fig. 33

Plaster Jacket and Spica on Bradford Frame.

Combination plaster jacket and spica for injuries of spine, pelvis, and hip joint. Transport on Bradford frame and canvas swathes.

See illustration of frame and swathe, page 127.
See description of frame, page 24.
See description of swathes, page 67.

Fig. 33

Fig. 34

Rubber Cloth Supporting Sling.

For support under wet dressings and discharging wounds.

A.B.—Light wooden bar as spreader to which cloth is tacked.

A.C.B.—Cord for suspension when limb supported from above.

Fig. 34

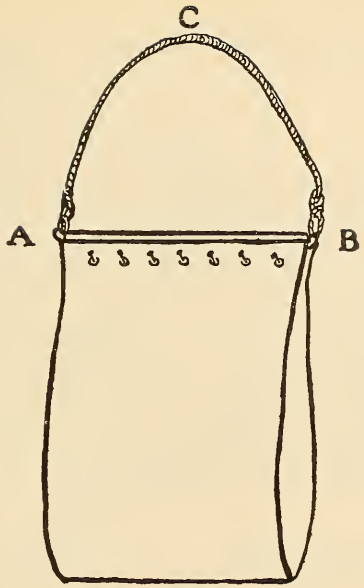


Fig. 35

Hennequin Traction Band.

Uses:—

(*a*) In injuries to the shaft of the femur with marked abduction of the short upper fragment.

(*b*) To maintain limb in position of flexion of hip, abduction of thigh and flexion of knee.

A. Heavily padded and bandaged limb.

B. Folded half sheet passed over thigh just above knee, crossed behind, and pinned on either side to itself.

C. Traction bands passed through loops of sheet made by folding over ends and pinning.

See description, page 48.

Fig. 35

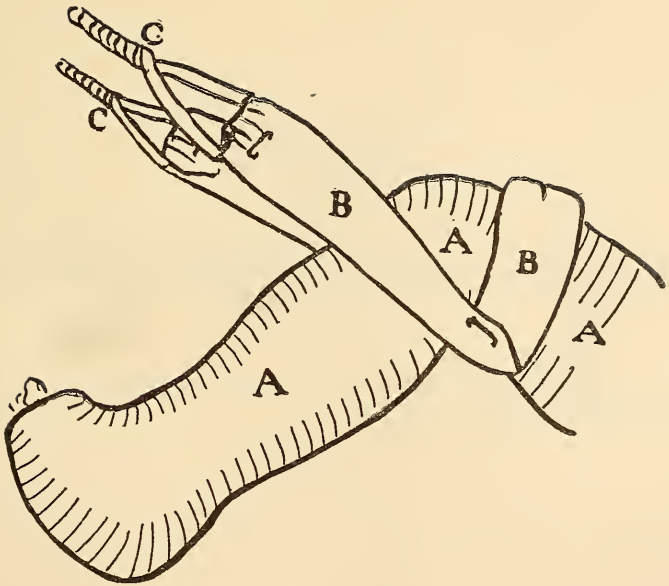


Fig. 36

CLIP.

To retain supporting slings on rods of wire arm and leg splints.

See description, page 64.

Fig. 36

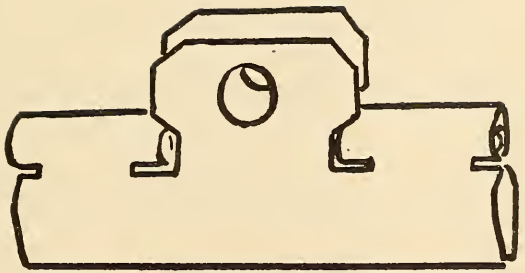


Fig. 37

Triangular Bandages.

For slings and quick application to retain dressings.

Dimensions.—Approximately 36″ by 50″.

Various methods of application.
Fasten by knots and safety pin at apex.

Fig. 37

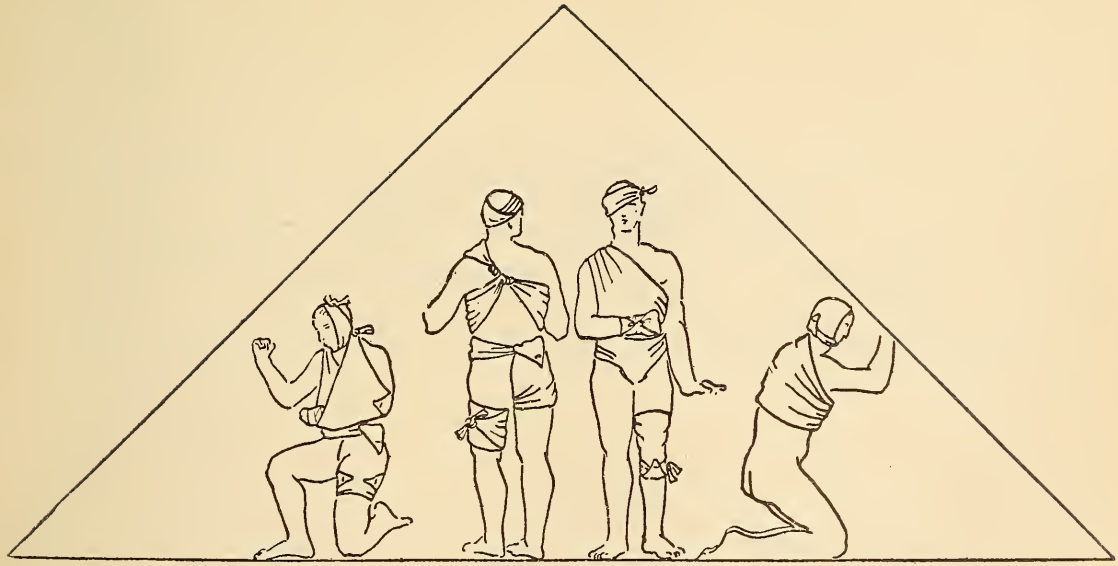


Fig. 38

SCULTETUS BANDAGE.

For abdominal or pelvic binder.

Dimensions.—Length, 52″; width, 12″.

See descriptions and uses, page 65.

Fig. 38

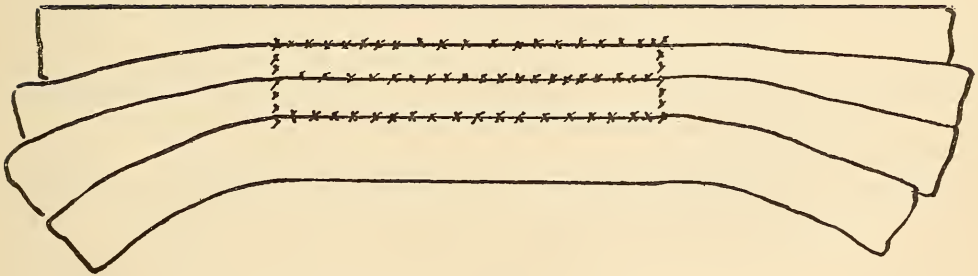


Fig. 39

Wire Gauze.

For supporting slings on wire splints where wounds are discharging profusely or irrigations are used.
For making light splints.
For core of plaster bridges, cut in strips, or folded in making plaster bridge splints.

See description, page 69.

Fig. 39

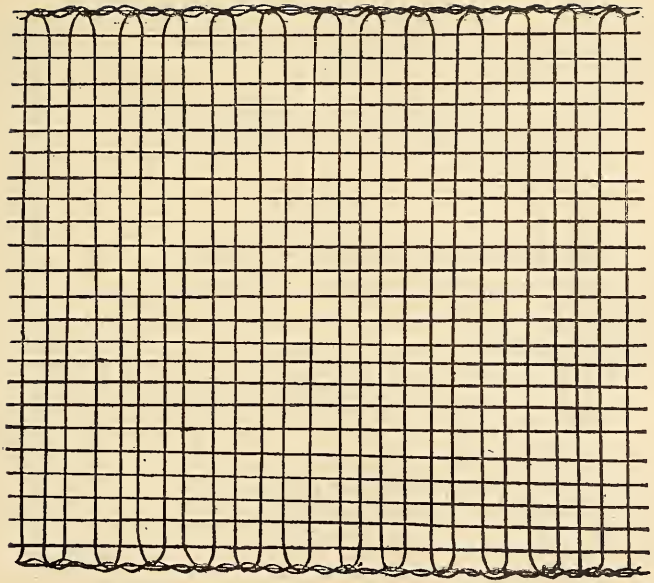


Fig. 40

Wooden Bed Frame.

For traction by weight and pulley and overhead counterweight suspension, see page 27.
Application for upper limb injuries.

Uses:—

(*a*) Injuries to the shoulder joint.
(*b*) Injuries to the shaft of the humerus.
(*c*) Injuries to the elbow joint.
(*d*) Injuries to the forearm.

A. Rubber cloth supporting sling tacked to spreader, see page 64.
B. Traction bands, see page 62.
H. Strap iron hooks, see page 70.
S. Spreader and hand grip.
W. Open canvas weight bags, see page 68.

Fig. 40

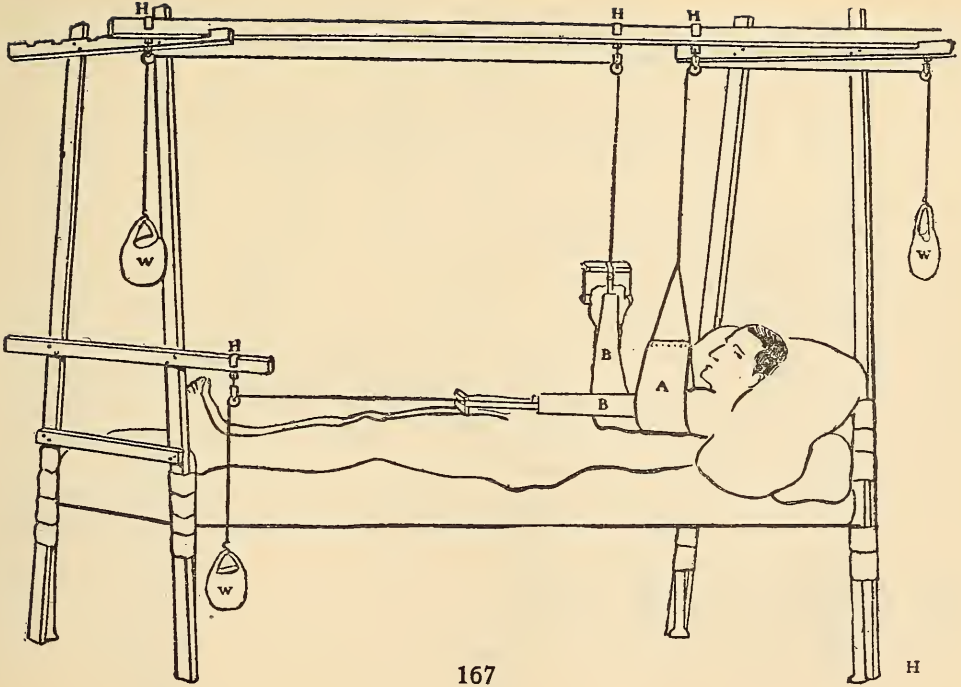


Fig. 41

Wooden Bed Frame.

For traction by weight and pulley and overhead counterweight suspension. See page 27.

Application for lower limb injuries, limb in slight abduction in hinged half-ring posterior leg splint.

Uses:—

(*a*) Injuries to the hip joint.
(*b*) Injuries to the shaft of the femur.
(*c*) Injuries to the knee.
(*d*) Injuries to the leg.

A. Supporting slings clipped to rods of splint.
B. Cloth glued to sole of foot attached to counterweight arranged to maintain right-angle dorsal flexion.
C. Hand grasps by which patient may change his position in bed.
D. Blocks to raise foot of bed.
H. Strap iron hooks, movable on upper cross bar of frame but screwed to short wood bar to maintain pulleys in proper relative position.
W. Open canvas weight bags.

See illustration of splint, page 111.
See description of splint, page 14.

Fig. 41

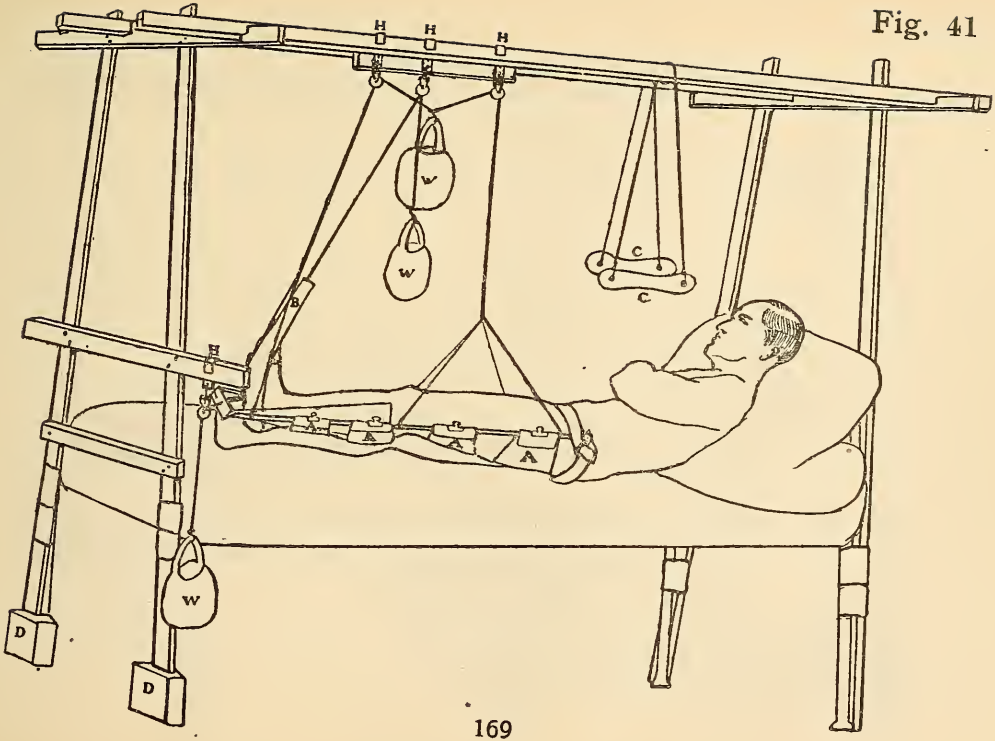


Fig. 42

Wooden Bed Frame.

For traction by weight and pulley and overhead counterweight suspension, see page 27.

Application for lower limb injuries.

Limb in anterior thigh and leg splint, Hodgen type.

Uses:—

For suspension of limb from overhead support in injuries of thigh and leg.

A. Supporting slings clipped to rods of splint.

B. Cloth glued to sole of foot attached to counterweight arranged to maintain right-angle dorsal flexion.

C. Hand grasps by which patient may change his position in bed.

H. Strap iron hooks movable on upper cross-bar of frame but screwed to short wood bar to maintain pulleys in proper relative position.

W. Open canvas weight bags.

See illustration of splint, page 119.

See description of splint, page 17.

Fig. 42

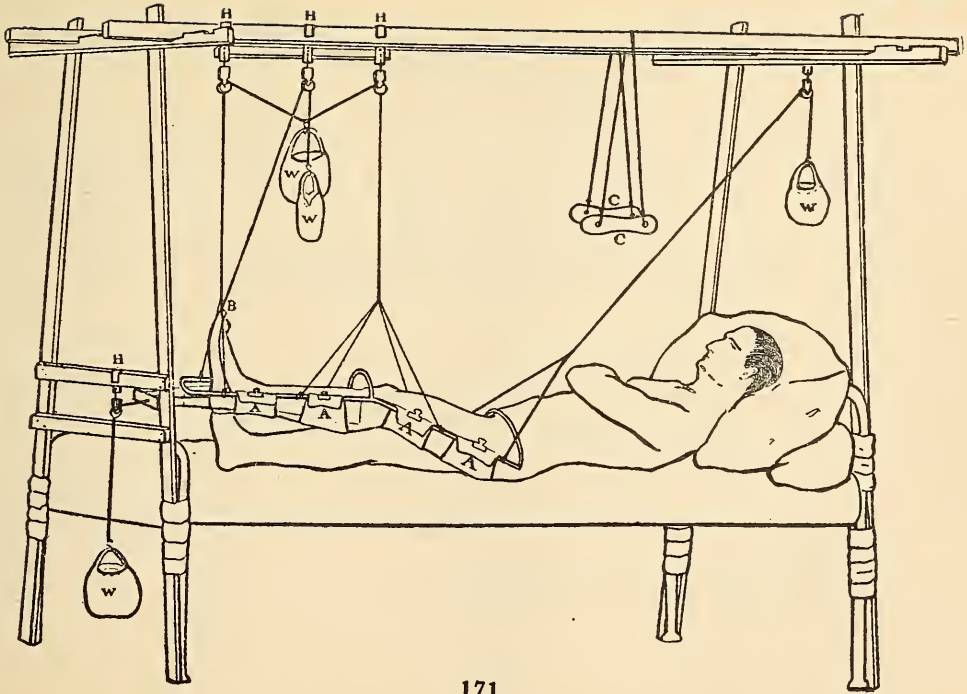


Fig. 43

Wooden Bed Frame.

Specially arranged for abduction of lower limb.

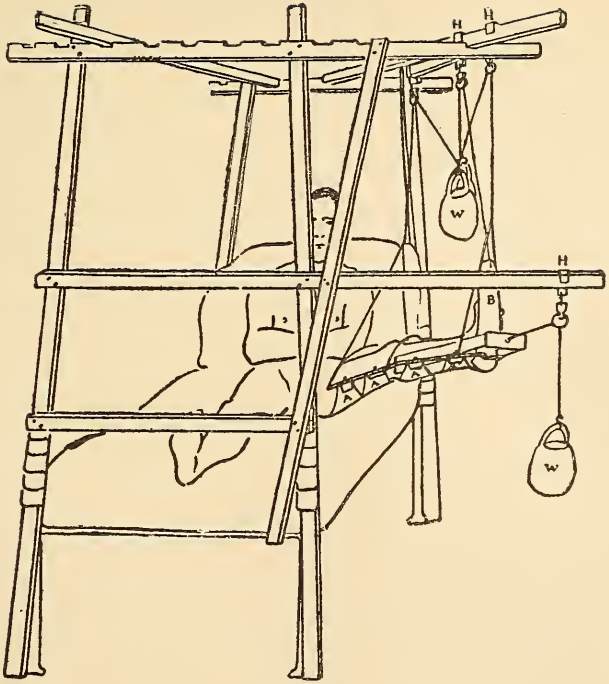
For traction by weight and pulley and overhead counterweight suspension, see page 27.
Application for maintaining flexion and abduction of limb in anterior thigh and leg splint, Hodgen type.

Uses:—

For suspension of limb from overhead support in injuries of hip joint and high femoral fractures.

A. Supporting slings clipped to rods of splint.
B. Cloth glued to sole of foot attached to counterweight arranged to maintain right-angle dorsal flexion.
H. Strap iron hooks.
W. Open canvas weight bags.

Fig. 43



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